

# Technology Review

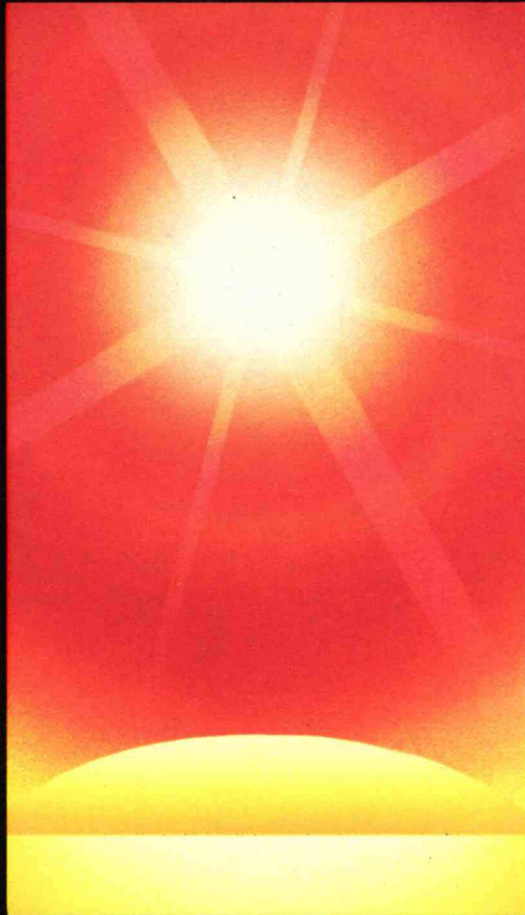
EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

JULY 1991

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## ALSO IN THIS ISSUE:

- ◇ *CROSSING THE BORDER  
TO EVADE ENVIRONMENTAL LAWS*
- ◇ *WHY TECHNOLOGY PREDICTIONS  
GO AWRY*
- ◇ *THE DEBATE OVER  
BOVINE GROWTH HORMONE:  
WHO SETS THE COURSE  
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- ◇ *COLORING THE  
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*Peaceful Nuclear  
Explosions*

## A PRACTICAL ROUTE TO FUSION POWER

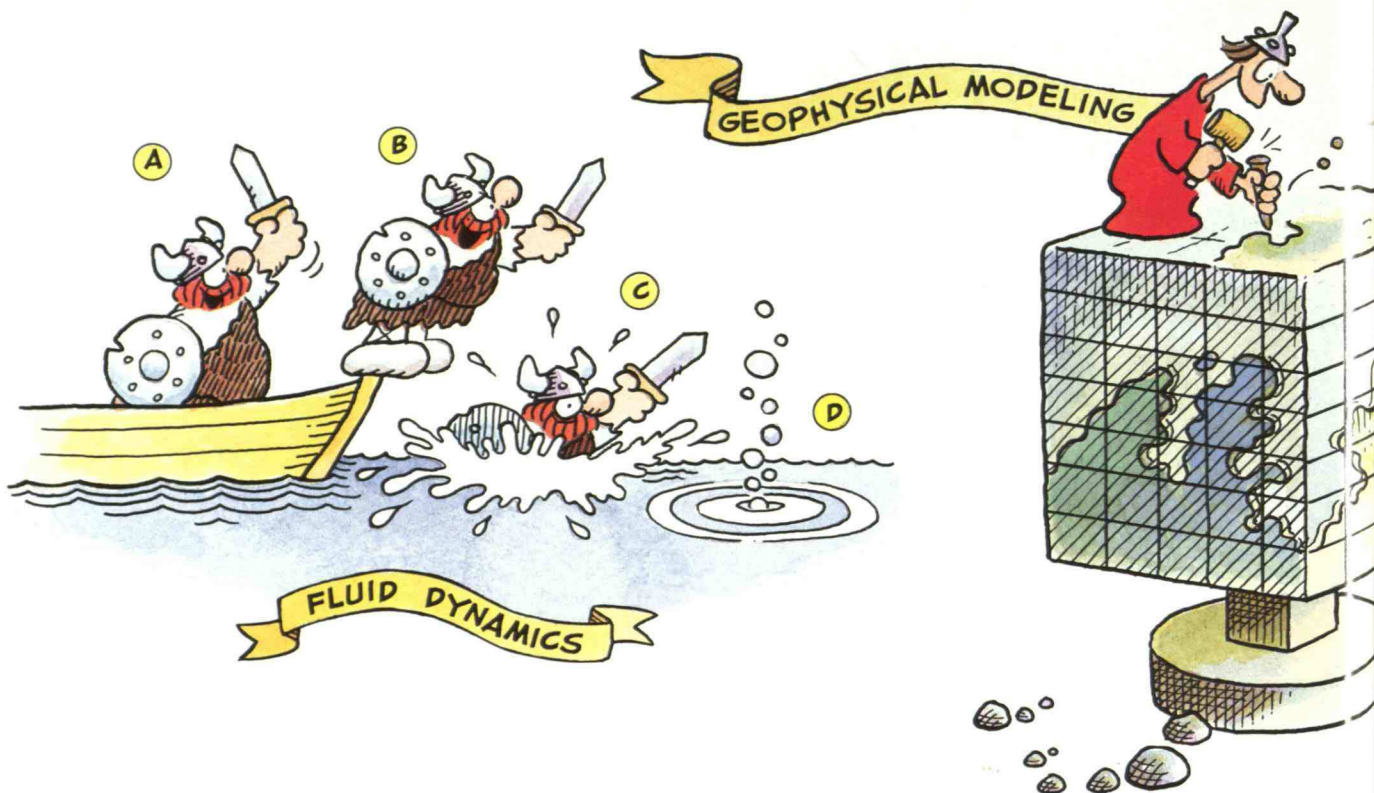


# technology review

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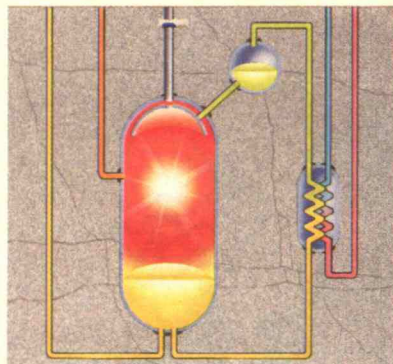
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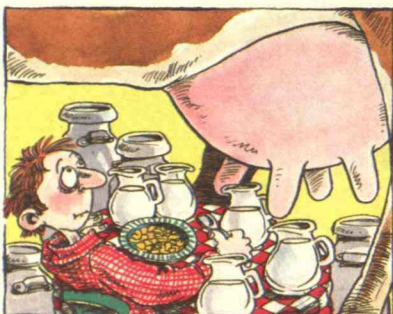


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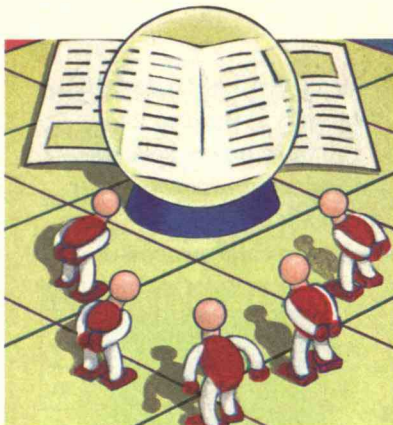
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COVER: Illustration: Gardiner Morse; Art Direction: Nancy Cahners;  
Design: Kathleen Sayre

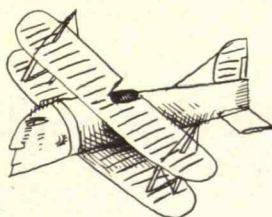
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## **Nuclear-generated electricity saves more oil each day than we used to import from Iraq and Kuwait.**

With more than 100 operating nuclear plants in this country, nuclear electricity cuts U.S. oil imports by 740,000 barrels every day. That's more than the oil we imported from Iraq and Kuwait before hostilities broke out last August.

Nuclear energy is a major reason why electric utilities here burn much less oil than

they used to. In 1973, 17% of America's electricity came from oil, while only 4% came from nuclear. Today, oil provides 4%; nuclear energy generates over 20%.

But America still imports about half the oil it consumes—the equivalent of four huge supertankers of foreign oil every day.

We need more nuclear plants—to meet America's growing electricity demand, and to bolster our independence from dangerously unstable energy sources.

For more information, write to the U.S. Council for Energy Awareness, P.O. Box 66080, Dept. ST19, Washington, D.C. 20035.

### **Nuclear energy means more energy independence.**

# FirstLine

## Editor's Queries

**W**ITH this issue I am leaving *Technology Review* to do some research and writing. One of the many things I will miss is the craft of editing, so I wanted to take the occasion to reflect on what editors contribute and what we learn through our work.

We of course have our role as guardians of the proper application of the parenthetical comma (both before and after the phrase), defenders against the misuse of "hopefully" (not a substitute for "I hope"), and arbiters of when to split an infinitive (whenever it sounds okay). More serious than the mechanics of grammar is the difficulty E. B. White aptly described: "When you say something, make sure you have said it. The chances of your having said it are only fair." Achieving clarity is much harder than most people realize, but doing so makes reading immensely easier, even when it occasionally requires what some writers consider a dogged repetition. (Note how White repeated the phrase "said it.") What White failed to mention is that when writers don't say what they mean, editors help them find the right words.

While authors often imagine that editors exist to clean up their prose, in fact editors' main job is to help with more serious writing problems, namely problems in thinking. Montaigne had the last word on these: "I hear some people apologize for their inability to express themselves, and pretend to have their heads full of good things which they cannot bring out through lack of eloquence. This is a delusion. Do you know what I think? These are shadows cast upon their minds by some half-shaped ideas which they cannot disentangle and clear up inwardly, and therefore are unable to express outwardly; they do not yet understand themselves."

Society invented therapists to help us all understand ourselves better, and publishers have long recognized a need for editors to help authors give co-

herence to those thoughts that are still partly shaped. Editors bring a disinterested but sympathetic perspective to authors' endeavors, raising questions that loom large but that authors may stubbornly avoid, pointing up contradictions (it is amazingly hard to be consistent), and helping craft arguments to meet the world's scrutiny.

Therapists may discuss patients if they change the names, but writers' identities cannot be hidden, so editors practice discretion. My experience as a writer allows me to suggest the sorts of scenes that pass across the editing table.

## *The questions that editors pose define a magazine.*

For example, when I went to discuss the draft of my May/June "First Line" with Sandra Hackman, the managing editor, I found it covered with scribbles. She said she had spent a lot of time on it because she thought I had some really interesting ideas. Then she asked a few questions. I got the gist. I scurried back into my office, completely rewrote what I then perceived to be a horrible mess, and, I hope, acquitted myself honorably. Inexperienced writers can sometimes be less gracious about rewriting because it means rethinking, not just pushing words around on the page.

While writers must develop reasonably coherent opinions into which their current work should fit, editors' view of the world consists mainly of a set of questions. This is not at all the same thing as a blank slate. The questions posed by the editors define a magazine. Those asked by the editors at *Technology Review* under my guidance do not, I think, differ essentially from the ones asked under the previous editor, John Mattill. The overriding question is: Can human beings prosper in the technological world of the late twentieth century?

What about this world is good, what is bad, and how can we improve it?

One of the pleasures of being an editor is the surprising answers authors provide to such questions. (If an article is so predictable as not to surprise the editor at all, why publish it?) Our current cover story looks at one perennial question that *Technology Review* examines: Can nuclear power provide a beneficial source of energy? Imagine my astonishment a year and a half ago when Abraham Szöke, an intense physicist from Lawrence Livermore Laboratory, sat down in my office and half-jokingly proposed generating power by dropping H-bombs in holes. Actually, the idea wasn't exactly that, he said—and wasn't as preposterous as it sounded—but he couldn't explain much more until his paper got security clearance. Would we be interested in looking at it?

The longer I live, the better I get at keeping an open mind, and the authors have good credentials, so I said yes. We worked with Szöke and Ralph H. Moir through several drafts, and, yes, I was pleasantly surprised by the outcome. At first they focused on the technique of producing power from small, contained fusion explosions. We asked sharp questions about the safety of the plants and their potential to spread nuclear weapons. I believe they answered these questions in a direct, straightforward manner, shedding light not only on their own proposal but on the major outlines of nuclear power itself.

The broad questions we have raised during my tenure at *Technology Review* will not be unequivocally answered but will be revisited for years to come. A search committee is deliberating but has not at this writing settled on a replacement for my position. For the time being, I leave the questions and the magazine in the able hands of Sandra Hackman and the rest of the editors. I now look forward with some trepidation to the questions that editors will ask me.

JONATHAN SCHLEFER

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# Letters

## JAPANESE EXPERTISE

"How Japanese Industry Is Rebuilding the Rust Belt" by Martin Kenney and Richard Florida (*TR February/March 1991*) is replete with the usual claims of Japanese expertise. The body of accepted statements about Pacific Rim business supremacy is now so large that academia no longer bothers to examine their validity or historical basis.

Nowhere in the article do we read about the closed markets that have confronted U.S. manufacturers who have attempted to sell products in competitive overseas markets. Some 15 years ago, when TVs in Japan cost some two to three times what they did in the United States, Zenith sought to export TVs to that country. They tried for years, but there was always just one more permit or trade license to obtain. So cleverly were these rejections worded that Zenith always kept its expectations up. In one burst of enthusiasm, the company went as far as to actually ship a load of TVs, but needless to say, they never got off the dock in Japan.

In contrast, the United States has flung open its immense consumer markets to all competitors without any quid pro quo. Therefore, while foreign competitors have been able to produce beyond what their home markets could absorb, U.S. companies have seen their business contract. Even today, foreign competitors are permitted to charge less for their products in the United States than at home. Any attempt on the part of the U.S. government to level the playing field or apply temporary quotas on imports is immediately branded as protectionism by American academics, who, after all, are largely immune to competitive forces. (What is tenure if not a protectionist wall?)

Now, after decades of unfair competition have driven U.S. manufacturers either out of business or into mere niche markets, Kenney and Florida would have us be thankful for Japan's takeover of U.S. industry. What obtuse intellectual gall! I dare say we will live to regret the day that we sacrificed U.S.-owned businesses on the ideological altar of one-way free trade. Our stagnant per

capita income over the past 20 years is just one regretful but predictable outcome.

A. DANIEL ELIASON  
Santa Barbara, Calif.

## The authors respond:

Blaming others for our own shortcomings will never result in the deep changes required to reverse our industrial slide. Our real problem is not foul play by other countries but a badly outmoded model of industrial organization and management that we use in heavy and high-tech industries alike. This old-style approach, associated with Frederick W. Taylor and Henry Ford, views workers as mere cogs in the machine. Our competitors, in contrast, see workers as a source of ideas on how to improve product performance, product quality, and the manufacturing process itself. This is why they are beating us in industry after industry, even though we started out with an overwhelming lead in science, technology, and manufacturing.

In the Japanese transplants that have sprung up in our industrial heartland, wages are similar to those of U.S. heavy industry, and in some cases so are the workers. The main thing that has changed is the system of industrial organization and management, and that has made all the difference.

Also, Eliason is simply wrong about televisions. Although Japan did protect its home market, Japanese corporations beat U.S. television producers right here in the American market. Superior televisions by Sony, Matsushita, Mitsubishi, and Toshiba were and are the underlying reason for this. And while Japanese companies were developing their ability to make world-class televisions, U.S. companies—RCA, GE, Westinghouse, and others—chose to abandon this field. Now Japanese corporations are bringing state-of-the-art television production to this country. Sony is setting up a new factory in the Pittsburgh area, on the site of the abandoned Volkswagen automobile assembly plant, where they will make large-screen color televisions.

## GLOBAL-WARMING DISPUTES

The cover of the November/December *Technology Review* advertises José Goldemberg's article "How to Stop Global Warming." The cover picture—a red sky with a blinding white sun—as well as the title of the article itself imply that global warming is a fact, when in truth scientists disagree on this subject and the empirical data do not substantiate any such warming.

MIT meteorologists Reginald Newell and Richard Lindzen both dispute that a warming trend exists. Newell has been quoted as saying that "there is no evidence at all" for "catastrophic change in our climate at the present time."

W.S. WHITE, JR.  
Columbus, Ohio

*The editors respond:*

We are well aware of both Lindzen's and Newell's views. It was an MIT Reporter article in our November/December 1989 issue that brought wide public attention to Newell's valuable research. However, as suggested by the very quote White uses, Newell focuses on the historical record and does not even study what could happen in the future. A broad consensus, though disputed in some respects by Lindzen, holds that catastrophic warming is a serious possibility. That is Goldemberg's view and was accordingly represented on our cover.

## POPULATION WOES

"Population Politics" by Werner Fornos (*TR February/March 1991*) is a most frightening, fair, and well-researched article. For many years I've felt that the population explosion has received far too little attention from environmentalists and the powers that be—not to mention the general public.

Instead of continuing to build megacities with their traffic and pollution problems and their endless urban sprawl, perhaps we could build "new towns"—towns of a limited size that would provide a wide range of work opportunities and residences as well as all the amenities for old and young. These

towns would be surrounded by a "green belt" so that they would not infringe on farms, wetlands, and all the other areas that need to be saved instead of turned over by the bulldozer. I've visited such towns both here and abroad and am deeply impressed with the idea.

MARTHA MUNZER  
Lauderdale-by-the-Sea, Fla.

Rev. Malthus has been dead for many years, and his ideas had little merit in his time. So why are they being propagated today in *Technology Review*?

"Population Politics" is typical of articles that center on modern population-control mythology—it includes the usual call for more abortions and even a gratuitous reference to the defense budget. All such articles require photographs of a Cambodian or Ethiopian refugee camp or Tokyo at rush hour. (Why not a shot of a Superbowl audience?) Packed together the way the people are in these photos, the entire population of the world would fit in Jacksonville, Fla.

OK, who could live like that? No one. So divide the world population into families of four and give each a lot measuring 50 by 100 feet. Now everyone could fit into Texas. But the Texans wouldn't like that, and no one could grow crops, so we could give all the people an acre per family. Now everyone could live in Australia. Projecting forward to the year 2010, you could put everyone in Africa and still leave room for the animals. As for feeding people, that wouldn't be difficult, either: everyone in the world could eat better than the average American for what we pay U.S. farmers not to farm.

This isn't a serious proposal, of course. It just puts the "problem" in perspective. What we truly need is not social planning but more social freedom. Look around. All that population control has brought to Western Europe has been a severe worker shortage. Also, socio-governmental structures tend to suppress the entrepreneurial spirit. Would you yourself want to move to any of the planned societies of the world?

*Continued on page 71*

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# MIT Reporter

## REBUILDING THE MIDDLE EAST

 Just hours after Saddam Hussein's army started to withdraw from Kuwait, American companies were lining up reconstruction bids. And within weeks, states such as cash-poor Massachusetts had compiled brochures on how to position businesses for work.

A group of MIT faculty see a different kind of opportunity in postwar Kuwait. They say that rebuilding the country offers a chance to introduce such things as cleaner technology, better education, and more efficient government. They are concerned, however, that the time to reflect and plan effectively may be lost.

"You can't worry so much about how buildings are constructed when there is an immediate need for housing," explains Philip Khoury, acting dean of humanities. "One worries," therefore, that "you reconstruct only to have it deconstructed again."

Khoury is one of a group of faculty working on reconstruction under the aegis of MIT's Center for International Studies. In the past few years, he and his colleagues have been studying the Middle East's war-torn areas such as Lebanon and Afghanistan. They've decided that focusing on physical and socioeconomic rebuilding can do more for peace than concentrating on conflict, says Myron Weiner, the center's director.

Many of the projects have concerned Lebanon. Under a \$4.5 million five-year grant, several faculty have combined forces with American University of Beirut to figure out ways to restore electric and water supply systems and housing in that country. After almost 20 years of civil strife, services in Beirut have deteriorated to the point where water is available for just three hours once every four days, and only those people with access to private generators have electricity.

For his part, Weiner is studying refugees, migration, and labor issues, primarily in Afghanistan. In August he plans to lead a team of faculty to Pakistan to help the Agency for Interna-



tional Development create independent organizations that could rebuild rural Afghanistan even before the civil war ends. In countries with weak governments, he says, it is critical to develop non-government reconstruction agencies run by local people.

Fred Moavenzadeh, director of the Center for Construction Research and Education, is concerned about how to pay for the rebuilding of the Middle East as a whole. The region has the resources for such an effort, he says, but it needs a guiding force to direct that money to development. He calls for a regional bank designed along the lines of the redevelopment bank recently created to aid Eastern Europe.

### Looking Anew at Kuwait

The Gulf war made the work of the faculty group all the more pertinent. Three years ago, the government of Kuwait asked Moavenzadeh to develop a plan for revamping that country's economy for the twenty-first century. Working with a number of MIT and Harvard University faculty, he explored everything from industrial development and population issues to environmental

*Shortly after the end of the Gulf war, a damaged desalination plant caught the attention of two Kuwaitis.*

concerns and government restructuring. Now Kuwait is asking the faculty to take another look at the plan in light of the war's destruction.


For example, instead of simply reassembling inefficient ministries and changing them later, perhaps officials could reorganize them at this time to work more effectively, explains Fauzi Al Sultan, a World Bank executive director who heads a task force that's planning Kuwait's reconstruction. But, he adds, it's not clear whether the upheaval of war has provided enough force to convince Kuwaitis to change their ways. In some recent cases, ministries have temporarily held up international relief packages containing food, blankets, and first-aid supplies.

The group says damage in Kuwait may not be as extensive as originally reported. They also point out that the country's wealth, political alliances, skilled workforce, and cheap labor put it in a better position to rebuild itself than any other war-torn country in his-

tory. Iraq, meanwhile, may be in the worst position. Before the Iran-Iraq war, the nation held the best promise in the Middle East for economic development, Weiner says: it had a well-educated middle class and a balance of agricultural and industrial sectors. He finds Iraq's devastation—brought on by enormous debt, political alienation, and internal and external war—"unbelievably sad." ■

By LISA WATTS, a Boston-based free-lance writer

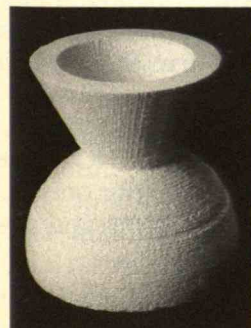
## DESKTOP MANUFACTURING

 First there was desktop publishing. Now there is desktop manufacturing. The technology, which enables manufacturers to produce a part directly from a computer model, could form at least a \$1 billion market within the computer-aided design and manufacturing industry, according to Terry Wohler, a Fort Collins, Colo., engineering automation consultant.

One of the more than one dozen new ideas in this field has come from three MIT engineers and their students. Emanuel Sachs, a mechanical engineering professor, and Michael Cima and James Cornie, materials science and engineering professors, have developed a technique that uses a computer to build up complex machine parts layer by layer in a bed of powder.

Because molds and dies don't have to be made, this method can cut several months of work and save between \$5,000 and \$50,000 or more for each

*Continued on page 12*



MIT engineers used desktop manufacturing to make this ceramic shell.

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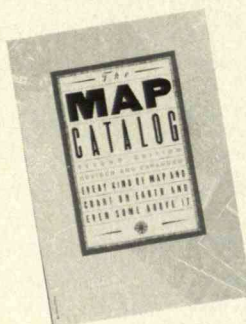
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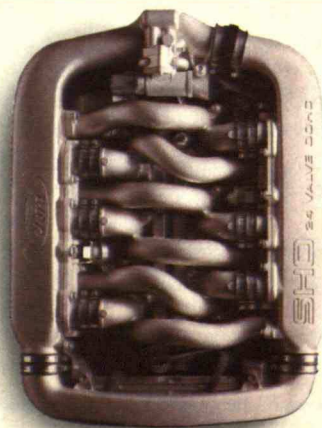
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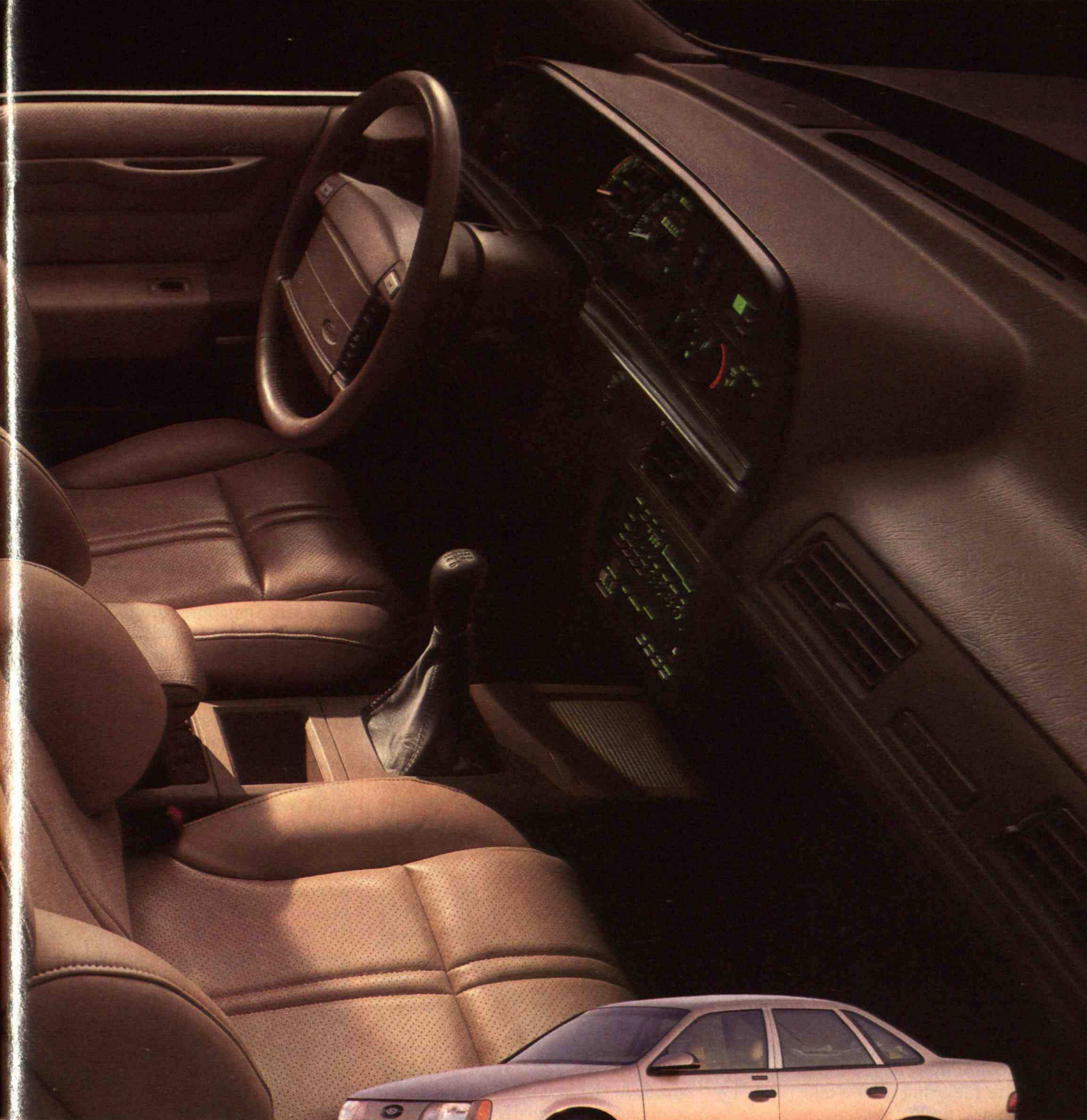
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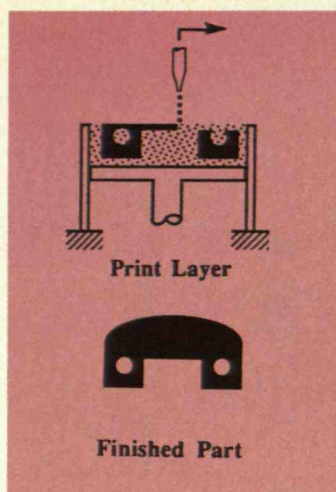
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*The MIT desktop manufacturing technique produces parts by squirting a binder material onto layers of powder. A computer program determines where the material should go.*

part, according to the inventors. They write in a recent paper that their process “virtually eliminates initial tooling costs, making prototyping and small production runs economically feasible.”

The method, which the researchers call three-dimensional printing, starts with spreading a powder layer thousandths of an inch thick. Then a “slicing algorithm” program based on a computer model of the desired part takes over. It instructs technology akin to an ink-jet printer to squirt a binder material such as colloidal silica in particular places on the powder. This process is repeated over and over to build up a part made of bound powder. Afterward all the unbound powder is removed and the part is strengthened through firing. In the future, the steps up to the firing should take just a few minutes, Sachs says.

Sachs, Cima, and Cornie want to use their technique to make ceramic molds. Such molds could be used in producing airplane parts and other components, according to Richard Aubin, a Pratt & Whitney project leader. At least one other set of researchers, associated with the University of Texas, is also developing a process to make ceramic parts directly.


It’s difficult to rank the various desktop manufacturing methods, comments Lee Weiss, a senior research scientist at

Carnegie Mellon University’s Robotics Institute. “The technologies are in their infancy,” he says. Eventually, they will be evaluated on their cost, speed, and accuracy, as well as on the kinds of materials they can work with and the strength of the products they make.

For their part, the MIT researchers are also investigating how their technique can be used to make porous ceramic “preforms” that can be infiltrated with liquid metal. In the future they may also examine how to use their process to make metal and plastic parts directly. ■

By DAVID R. LAMPE, editor of The MIT Report, and LAURA VAN DAM, a Technology Review senior editor

## MIGHTY MOUSE

 David Otten has built what appears to be the world’s quickest maze-running robot—a “micromouse” that can speed along at almost 12 feet a second.

The electronic rodent is one of six developed as a hobby by Otten, principal research engineer in MIT’s Laboratory for Electromagnetic and Electric Systems. Like his other micromice, MITEE 6 uses infrared sensors, small motors, and a microprocessor to find its way to the center of a 10-foot-square wall maze. The mouse first performs a searching run, storing the placement of walls in its memory and determining the most efficient path. Then it tries for speed. In the international micromice competitions, the goal is to complete the maze as fast as possible within a 15-minute limit. Otten’s mouse can accelerate on straightaways, turn quickly, and run sections of the maze in a diagonal straight line.

“It goes through the first time pretty slow, then faster and faster until it crash-

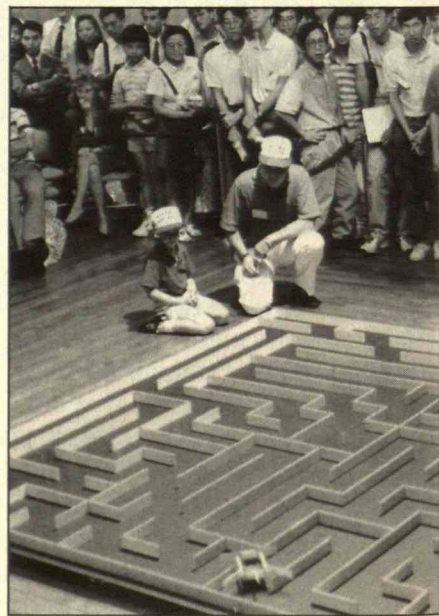
es,” Otten explains.

The robot’s speedy style has led to a sweep of victories in micromouse competitions in Los Angeles, London, Toronto, and Tokyo. In Hong Kong, a similar Otten creation, MITEE 3, took the prize. (MITEE 6 could not compete there because of maze conditions.) “We saw MITEE 3 and decided it was the ultimate mouse,” says Harjit Singh, a La Palma, Calif., hobbyist trying to improve on Otten’s robot.

Otten thinks that building micromice could be an “excellent educational tool” for students, since it requires skills in computer science as well as mechanical and electrical engineering. Engineering schools in Singapore particularly push it, he notes. The activity is also catching on in California. Some schools, including the University of California at Davis, even offer credited courses in micromouse construction.

Along with small monetary awards, Otten has won some unique trophies. In London last year, officials presented him with a large brass wedge of Swiss cheese. No wonder his competitors are trying to build a better mousetrap. ■

By JOHN TRAVIS, a free-lance science writer



*Accompanied by his son Jimmy, MIT research engineer David Otten watches as his electronic mouse MITEE 3 speeds to victory in a Hong Kong race.*

# Trends

## Pentagon Pollution

In March 1991, Richard Armor was sentenced to six months in jail and five years' probation for storing the largest cache of toxic and explosive chemicals ever discovered in California. The case began when the businessman's neighbors in Collinsville reported suspicious activities at an abandoned barn. State environmental investigators found the barn filled with drums containing tens of thousands of gallons of toxic material. Many of the drums were dented, leaking, or corroded. Side by side were volatile chemicals that are illegal to store together.

For the ensuing emergency cleanup, the state dispatched two dozen workers and evacuated nearby residents. Some material was too toxic to move and was exploded on site. The effort took weeks and cost California over \$1 million.

Still, the trial largely ignored a fact that intrigued the cleanup crew: all the barn's waste clearly bore the labels of the U.S. military. And while many drums contained common industrial solvents and acids, some of the contents were more exotic. Several containers, for instance, held highly corrosive and toxic Decontamination Solution #2, or DS2.

Described in Army memos as "nasty stuff," DS2 is stockpiled at virtually every Army hospital and base in the United States and abroad. In the event of a chemical war, the decontaminant is to be sprayed on vehicles and machinery. Armor had purchased the DS2, like the other chemicals in the barn, at Defense Department surplus material auctions. These are handled by the Pentagon's Defense Reutilization and Marketing Service (DRMS), which operates more than 200 regional offices worldwide.

Unfortunately for Armor, who acquired DS2 as part of his purchases of dozens of mixed lots of paints, solvents, and other chemicals, it has no civilian use. "There's a joke about it

around here that you could use it as fingernail polish remover," says Pentagon spokesperson Nancy Dunn. "But you might never see your fingers again."

At least four other sales of DS2 to the public have come to light. According to a General Accounting Office (GAO) report released in 1990, an unnamed individual bought 275 gallons in 1988 from the DRMS office at Kirtland Air Force Base in New Mexico. The individual told the GAO he didn't know what he was buying, but when he went to pick up the material and expressed concern about potential hazards, he was told to take it or be barred from future auctions. In the past few years, drums of DS2, which could only have originated from the military, have been discarded alongside a highway and dumped in a locked vacant lot owned by the Port of Los Angeles.

### Bleach Is Better

In response to such incidents, a congressional hearing was conducted last year at the request of Rep. Vic Fazio (D-Calif.), whose district includes the Collinsville barn. Since then, the Defense Department has said that, within the United States, it will sell DS2 only to bidders with a licensed ability to break the material down for recycling. Going farther, the Navy and Air Force won't purchase

*According to a Pentagon joke, DS2 "could remove nail polish, but you might never see your fingers again." Still, the military sells such toxic material to the public.*

any more DS2. They say they don't need it, since adequate decontamination can be achieved with detergent and water.

The Army has refused to adopt that alternative, however. Its U.S. installations still receive DS2 shipments, and many continue to increase their inventories of it. Several months prior to the Persian Gulf war, Brig. Gen. David Nydam told a congressional committee unequivocally that the



Army "requires the availability of a decontaminant which can effectively be used in an efficient and immediate manner in locations where water may be severely limited in availability."

Unfortunately, DS2 may not be that substance. The 1990 GAO investigation found that Army tests six years earlier had concluded DS2 could make M1 tanks inoperable. According to the test reports, DS2 "severely damaged electrical components and cables." Also, the chemical caused the "rubber road wheels and track of the tank to decompose and damaged the tank's periscopes." The Army tests also showed that an M1 decontaminated 12 times with household bleach still ran fine.

Aside from noting such "definite limitations," Gen. Nydam testified that DS2 "presents no more of a stor-

age and disposal problem than any other hazardous material used by the Army." But Thomas Ward, who led part of the GAO investigation, reported that "everywhere we looked, the drums were leaking. We never found any storage sites that didn't look bad." And at least 26 Army units have asked to return portions of their DS2 inventories. Says one Army report, "Every commander [the GAO investigators] talked to wants it off installation." Last year, according to the Army, \$14 million worth of DS2 was turned in, an amount equal to more than a million gallons at Army prices.

Rep. Mike Synar (D-Okla.) and others think DS2 is one example among many of the military's lax handling of toxics. Critics suggest that the DS2 sales, the Army's resistance to alternatives, and the storage hazards relate to broad questions about the military's use of such substances.

Referring to the Collinsville incident, Synar calls "the sale of many of these hazardous materials . . . nothing less than a fraudulent disposal of hazardous waste in order to avoid the high cost of proper disposal." He charges the Pentagon, "one of the nation's largest generators of hazardous wastes," with mismanaging "the hazardous materials it uses and the wastes it generates."

The Defense Department has paid nothing to California or Los Angeles for efforts to dispose of DS2. Under the Superfund law, a private company in a similar situation could be liable for cleanup costs, but the military insists it is not responsible for materials the DRMS sells.

Finally, in response to the Collinsville incident, Kevin Doxey, director of the Pentagon's environmental restoration program, says the military now removes its markings from all toxic materials it sells. ■

*By Seth Shulman, a contributing writer to Technology Review and author of a forthcoming book about military toxic waste*



## The Soviets Convert . . . Sort Of

When Mikhail Gorbachev addressed the United Nations in December 1988, he announced that a hallmark of his reforms would be reducing the Soviet military budget and converting his nation to a civilian economy. Over the next two years, the Soviet Union duly cut its military budget and production dramatically and concluded treaties with the United States to radically reduce weapons stockpiles and conventional forces in Eastern Europe and Asia.

"Gorbachev and his supporters agreed with Western critics of military spending," says Randall Forsberg, director of the Institute for Defense and Disarmament Studies (IDDS). "They believed that deep cuts in their defense budget combined with conversion would revitalize their economy." At a U.N. conference in Moscow last August, Columbia University economist Seymour Melman heard several Soviets call conversion their country's

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*Many Soviet economists think that converting the country's extensive military industry to civilian production might offer one last hope for a healthy economy.*

"last chance for recouping economically."

Nevertheless, conversion is proceeding very slowly. "The centrally planned Soviet economy has proved to be not very well prepared for efficient, large-scale conversion of the military economy," noted fellow economist and conference participant Alexei Izyumov of the Institute of the United States and Canada, which is part of the Soviet Academy of Sciences. Last year, military production consumed over 20 percent of the GNP, according to unofficial Soviet estimates. Up to 40 percent of machine manufacture and 75 percent of R&D may still be defense-related.

"Economic doctrine has held that conversion would not be a problem because they have Gosplan, the state central planning committee," says Melman, a collaborator with Soviet experts on conversion studies since

1979. Gosplan prepares a menu of products and parcels them out to particular enterprises. Unfortunately, Melman notes, "there is often no connection between new civilian products and the work an enterprise used to do." For example, the Soviet Union desperately needs passenger planes. But Gosplan told Ilyushin, a major Soviet maker of military and commercial aircraft, to design and produce spaghetti packaging machines and equipment for peeling potatoes and treating furs and hides.

On tours of Soviet factories in similar predicaments, Melman has asked his hosts, "If you have no experience with the machines you are producing, how can you supply spare parts? Write maintenance manuals?" In reply, the engineers simply grin, since they have raised these same issues with Gosplan.

For conversion to work, Melman thinks that each base, lab, or factory needs a planning committee staffed by both management and labor. Gosplan, however, "considers local involvement a threat to its power and prestige."

Forsberg cites another obstacle to conversions: all too often, they result in lay-offs and production slowdowns. At the same time, military opposition is increasing as soldiers returning from Asia and East Europe face unemployment and homelessness. And Alexander Konovalov of the Institute of the United States and Canada points to the military's conversion problems, such as recycling scrap from thousands of tanks, artillery, and other armaments withdrawn from East Europe. The equipment is rusting along roadsides behind the Urals. "[Soviet] conversion advocates have to stand in the generals' shoes and help them find workable solutions," Konovalov maintains.

### Talking Solutions

Frustrated by the pace and inefficiency of official conversion, some enter-

prises are inventing their own approaches, shedding pre-glasnost secrecy, and looking abroad for partners, capital, and consumers.

Local authorities often aid these efforts, spurred by the interest of the Soviet republics in economic separatism from Moscow. Last November, the New York-based Council on Economic Priorities (CEP) commended the Leningrad city council for its independent conversion plan. It focuses on privatizing smaller factories first and converting dual-use facilities to completely civilian production. "It's easy to make fun of Soviet mistakes in civilian production," says CEP economist John Tepper Marlin. "The real issue is the will to convert." Up to two-thirds of Leningrad's industry is probably military-related.

To help reduce both political and economic tension, the National Conversion Foundation, a private organization headquartered in Moscow, is promoting several alternatives to of-

*Some Soviet conversion is poorly thought out. For example, the government told aircraft maker Ilyushin to produce spaghetti packaging machines instead of more passenger planes.*



ficial bottlenecks. The ideas include direct ties between northern European companies and converted enterprises in the Baltic republics and some cities in northern Russia.

According to Forsberg, leaders of the foremost Soviet defense enterprises came to a conversion conference in Cambridge, Mass., last fall with "direct and serious proposals for business partnerships with American companies." The suggestions ranged from aircraft to optics to semiconductors. However, Forsberg says, joint ventures often founder on the Soviets' inefficient communications and delivery systems and their inexperience with marketing, quality control, and questions of copyright and ownership. To set up business in Moscow, McDonald's had to grow its own potatoes, and Kellogg's will import Argentinian corn for a factory it's building in the Soviet Union.

In lieu of joint ventures, Dean LeBaron, founder and trustee of Batterymarch Financial Management in Boston, proposes "strategic alliances" between U.S. and Soviet partners. Joint ventures, he explains, tend to be complex and time-consuming to negotiate, but a strategic alliance simply requires a stock swap. "It's more of a buddyship, with both sides committed to cooperation, exchange, and progressive expansion."

LeBaron and his staff plan three funds totaling \$400 million or more for investing in aerospace, electronics, or diversified industries such as metal working. A Soviet partner would make a proposal, and a U.S. company would invest a minimum of \$20 million. Working with the Ministry of Defense Production, Batterymarch has set up offices in Moscow and Leningrad to pinpoint investments and start the joint stock companies. "The talk on both sides is of solutions," says Batterymarch director Ashu Rajbhandari. ■

By ANN MARIE CUNNINGHAM, a contributing writer to Technology Review



*This Dutch New Guinea door shows an awareness of the human fetus. Our improved knowledge gives rise to ethical and medical issues.*

## Furor Over Fetal Therapy

■ The first successful open-womb surgery has led some specialists to predict that intrauterine operations may become the best way to correct a host of fetal defects. Part of the growing field of "fetal therapy," such surgery moves prenatal care beyond caring for pregnant women to caring for the fetus itself. But the therapies also stir opposition on both medical and ethical grounds.

Pediatric surgeon Michael Harrison of the University of California School of Medicine has been in the forefront of research on fetal treatments and at the center of these controversies. In 1989 he and his colleagues repaired a diaphragmatic hernia on a 24-week-old fetus inside the woman's uterus. In this condition, which affects about 1 baby in 2,500, the diaphragm doesn't close properly, so abdominal organs grow into the chest. That

leaves lungs little room to develop, making it hard for a baby to survive.

Because treating fetuses directly is so difficult, doctors tend to shy away from prenatal operations and would ordinarily correct a diaphragmatic hernia after birth. But Harrison made a small incision in the woman's uterus and in her fetus. In the *New England Journal of Medicine*, his team reported they had reduced the surgical risks enough to avoid unduly endangering the woman, and they recommend trials to verify the treatment's effectiveness. If the trials succeed, they feel, parents should be able to choose fetal surgery as an alternative to postnatal treatment.

Despite Harrison's advances, some doctors feel the surgery is still experimental, and they are wary of the risks any surgery poses to both the woman and her fetus. And while Harrison maintains that a diaphragmatic hernia kills a baby 75 percent of the time, at least three teams have achieved a 75 percent survival rate with better care and therapy after birth.

For example, Thomas Tracy and his colleagues at the St. Louis University Medical Center wrote to the *Journal* that the argument for fetal intervention "misrepresents the current status of optimal postnatal care of these infants." Similarly, Columbia University pediatric surgeon Charles Stolar praises Harrison's advances but he, too, disputes the "premise of a 75 percent mortality rate." Stolar and others urge caution in considering Harrison's experimental approach over postnatal therapy.

### Whose Rights Prevail?

While the medical debate centers on specific treatments and postnatal therapy, ethicists are raising broader con-

cerns about the focus of care before a baby is born. They worry that treating a fetus as a patient could put it in an adversarial relationship with the pregnant woman.

Medical sociologist Caroline Kaufmann suggests that fetal therapies change the relationship of health care professionals to pregnant women. In *Reproductive and Genetic Engineering*, Kauffmann has written that the growing ability to visualize, diagnose, and treat the fetus can make it, rather than the pregnant woman, the primary subject of care, in effect reducing women to "gestators."

According to Janice Raymond, who teaches medical ethics at the University of Massachusetts at Amherst, "As the fetus is increasingly separated from the woman [for health care], it acquires more and more rights." This raises a danger that a fetus's rights will eclipse those of the mother. "The fetus is clearly the patient and the mother is the environment," she says.

In certain cases, notes retired Harvard University biologist Ruth Hubbard, pregnancy might pit "the welfare of the fetus against the welfare

of the woman." A woman might be expected to accept the risks that accompany surgery to protect the health of her fetus. Already, courts have ordered caesarean sections on women who refused that operation for religious, moral, or other reasons. In a 1987 survey of the heads of fellowship programs in maternal-fetal medicine, researchers at the University of Illinois College of Medicine and Hampshire College found that "46 percent . . . thought that women who refused medical advice and thereby endangered the life of the fetus should be detained."

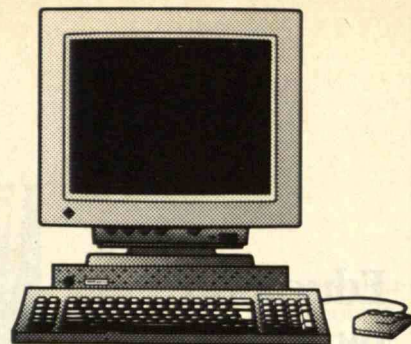
Hubbard points out that public concern for the fetus has even led to the arrest of women in the delivery room for child abuse when traces of alcohol or drugs have been found in the fetus. "Is there going to be legally mandated fetal therapy?" she asks. Harrison's team states that the family's choice should be respected, but, says Hubbard, "If you tell the future mother of a wanted baby that this is the only way it will survive, then what does consent really mean?"

Her question has special significance in view of the coverage of Harrison's pioneering work. Despite the disputed mortality statistics, most news articles repeat his claim that the hernia is usually fatal, and some barely mention advances in postnatal therapy. Such misleading information reinforces fears that a woman would be expected to put a fetus's welfare before her own.

"The problem is that we are not looking at maternal health," says Caroline Whitbeck, who teaches medical ethics at the Harvard-MIT Division of Health Sciences and Technology. She believes the emphasis on fetal surgery distracts attention from care for the mother as the source for healthy babies. "We need good prenatal care for the benefit of both the mother and child." ■

By ANNE DETWEILER, assistant circulation manager at Technology Review

*Emphasizing surgery could put a fetus in an adversarial relationship with the pregnant woman.*



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## Education by Satellite

In rural Kentucky, technology can bring advanced French and physics to virtually every school, no matter how small or remote. With a satellite and television, a pilot project is beaming lectures to distant classrooms. It even lets students talk back to teachers.

Since 1989, students in isolated Kentucky schools have been taking specialized courses through the Star Channels system. "For us up here in the mountains, that's what we need—exposure," says Wolfe County High School principal Charles Tapley. Hiring a full-time physics or statistics teacher for just a few students would cost Wolfe County over \$20,000. In-

stead, the county school system pays \$3,000—half the equipment cost—and \$300 for each student taking the year-long courses developed by Kentucky Educational Television (KET) and the state Department of Education. In the program's first year, two Wolfe County students took statistics and seven enrolled in physics.

KET transmits all the courses from its Lexington studio to a satellite 22,500 miles above the earth for relay to 78 Kentucky high schools. KET also sends the statistics class to 120 schools in 17 other states, and 50

schools in 15 states use the physics course.

In the Kentucky program, participating classrooms have one TV monitor, plus a computer keypad for each student. The students use the keypad for taking tests, answering multiple-choice questions, and asking teachers to go faster or slower. With phone hookups to each school, teachers in Lexington can answer questions and have some students work out problems while others listen. And through electronic mail software called Learning Link, students can communicate with teachers or other students in far-flung districts. For problems with assignments, Star Channels students can call toll-free phone numbers to reach three tutors after classes and on weeknights. Chuck Duncan, who teaches the physics course while on leave from

*Through the Star Channels system, students in rural Kentucky high schools can take specialized satellite courses in physics, math, and foreign languages. That helps break down the isolation of such schools.*

① Instruction is presented in the television studio.

② Uplinked to the satellite.

③ Downlinked to the school.

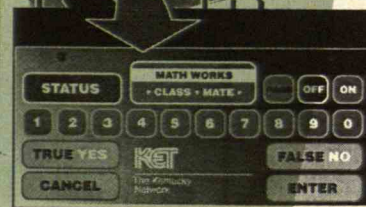
④ The students receive the instruction on television.

⑤ They interact with the teacher using their keypad devices and telephone.

⑦ The teacher monitors the student responses (voice and data) and modifies instruction accordingly.

⑥ The data from keypads and telephone is delivered to the studio via telephone lines.

### KET'S KEYPAD SYSTEM INTERACTIVE DISTANCE EDUCATION

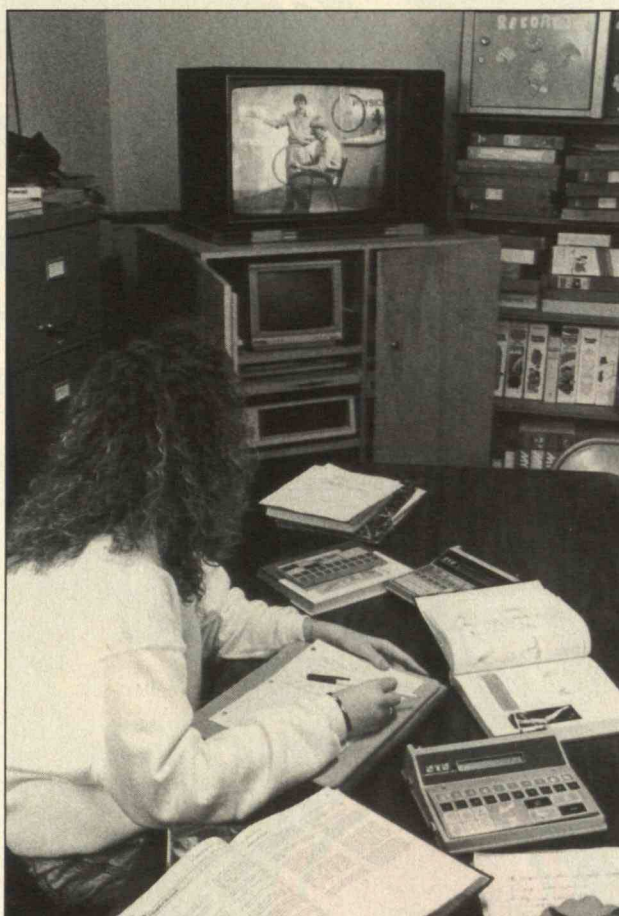


a Lexington high school, believes the links help overcome isolation and provincialism.

The federal government funded the \$1.2 million operating costs of the pilot project, an \$11.4 million state bond issue paid for most of the equipment, and KET had planned to spend about \$23 million more over two years to complete the original project, increase the number of courses to 10, and equip all public high schools for the system. When the state supreme court ruled in 1989 that inequities between rich and poor districts made the Kentucky school system unconstitutional, some legislators asked KET to expand Star Channels. KET then proposed a four-year plan to install it in all of Kentucky's 1,200 public elementary, middle, and high schools.

KET came up with a plan to provide the high schools with a comprehensive curriculum in foreign languages, the arts, and advanced math and science. Elementary and middle schools would use broadcasts for special classes, such as foreign languages. Some universities and libraries would join the network, so students and teachers could gain access to even more experts and resources. Moreover, the system could supply teacher in-service training or administer achievement tests.

The 1990 Kentucky General Assembly responded with \$16 million for the next two years for more computer keypads, satellite dishes, and equipment at a new KET building. It appropriated \$8.8 million more so KET could offer more courses. Besides physics and statistics, KET has begun broadcasting first-year German and two college-level math courses; Latin, pre-calculus, and second-year German will be added in 1992.



*All Star Channels students have a keypad for taking tests and responding to questions. A teacher can immediately find out if they are giving the right answers.*

### Calling on All Hands

The satellite curricula have made rural schools feel that "for the first time they are able to offer courses that make them comparable to wealthy ones," notes Jennings Bryant, director of the Institute for Communication Research at the University of Alabama. Bryant is evaluating an educational-TV consortium that serves schools in 30 states.

But while Star Channels may have vast potential, "good television programs teach well; poor ones teach poorly," cautions David Anderson, a psychologist at the University of Massachusetts in Amherst. On the plus side, he explains, televised instruction

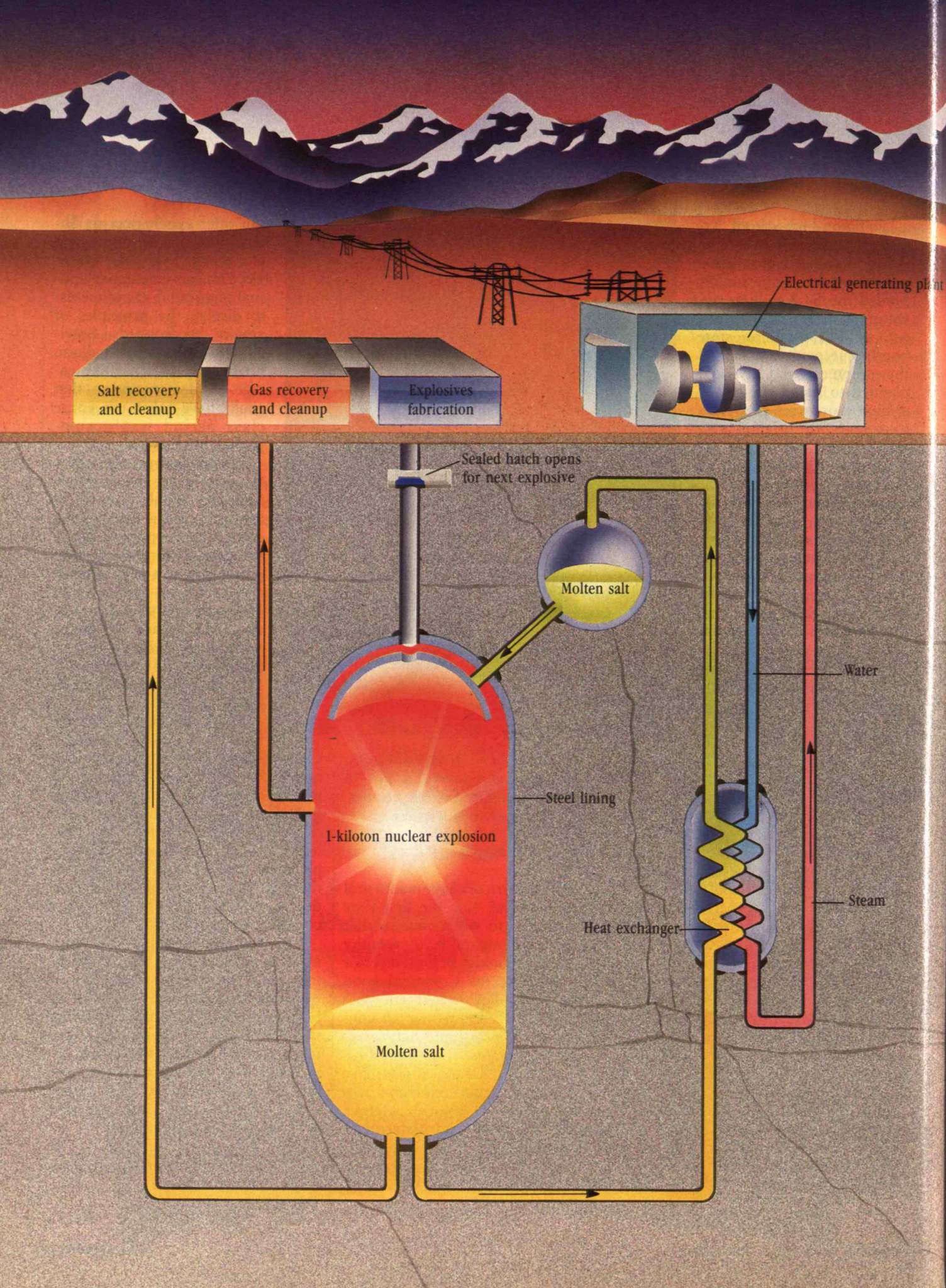
can offer experiences or observations that are impossible in a regular class. For example, Duncan videotapes unusual physics lab experiments: to display the principles of gravity, he dropped a bowling ball and a water balloon off the top of a parking garage. A demonstration that could have taken an entire class period was accomplished in minutes.

Satellite courses also allow a teacher to get an immediate computer profile of students to see if they are answering questions correctly. While some students may hesitate to participate in a regular class, everyone takes part in a Star Channels course via the individual keypads. In effect, says Tom Graviss, who teaches the statistics course, "We pick on all of the kids, hands up or not."

But Anderson adds that TV instruction can be ineffective unless students complete regular homework assignments. Thus, Kentucky's satellite students, who are graded and given credit just as in any class, do just that. For his statistics tests, Graviss relies mostly on multiple-choice and true-or-false questions that can be answered on the keypads during class or sent out through a computer or by mail.

Finally, Anderson notes, TV learning should supplement regular teaching, not substitute for it. A trained monitor—sometimes a teacher or librarian—is in the actual classroom with Star Channels students. A live teacher "gives students the human approval and reward that are essential to academic motivation," says Anderson. "A major reason kids study hard is to please the teacher." ■

*By GIL LAWSON, a staff writer for the Louisville Courier-Journal*



# A Practical Route to Fusion Power

*Small underground nuclear explosions could supply the world's electricity for centuries to come. Unlike other forms of fusion, this technology is feasible and affordable now.*

THE taming of fusion energy—the force that makes stars shine and thermonuclear weapons explode—has proved one of the most tantalizing and frustrating quests of science and engineering. The world has enough fusion fuel to satisfy humanity's energy needs for centuries. But despite close to 40 years of research, laboratories have been unable to generate more energy from fusion than is required to get it started. A commercial reactor remains a mirage.

Yet a possible solution lies under our noses. Startling as it might seem, the most practical and economical course is to detonate small fusion blasts a few times an hour in underground chambers and extract the energy that's released. Jets of molten salt would carry the heat of the explosion through

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BY ABRAHAM SZÖKE AND RALPH W. MOIR

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a heat exchanger to create steam, which would drive conventional turbines to generate electricity. The salt jets would also carry waste and unused fuel from the chamber to an on-site plant that would recycle the usable materials into fresh explosives. The rest would be solidified, packaged, and stored deep underground, possibly at the reactor site.

We call the system peaceful nuclear explosives, or PNE. A PNE power station would use fission explosions to ignite the fusion explosions. At first, the fission explosions would supply most of the total PNE energy. We hope that over time, engineers would find ways to set off fusion explosions with smaller and smaller fission explosions, evolving to a system that produces as little as 10 percent of the energy from fission and reducing the amount of waste produced by a proportional amount. Even if that never happened, however, a PNE plant would still be economically competitive with—and as safe as—other nuclear technologies. In fact, a PNE plant would produce a tenth as much waste as a conventional fission plant.

The key advantage of fusion is that the fuel is essentially inexhaustible. A fusion reactor would work by forcing the energy-releasing merger of deuterium and tritium— isotopes of hydrogen with one and two extra neutrons. Deuterium is abundant in water. Tritium is scarce in nature, but can be created by bombarding lithium with neutrons, which the fusion reactor would produce in abundance. In a sense, then, fusion plants really burn lithium, which is common enough to allow centuries of fusion power.

Nearly all the research aimed at producing electric power from nuclear fusion has so far focused on two broad approaches: magnetic confinement and inertial confinement. In magnetic fusion, magnetic fields confine a hot “plasma” of deuterium and tritium. In inertial-confinement fusion, or ICF, a laser beam or stream of high-energy subatomic particles strike a tiny pellet, heating and compressing its small load of deuterium and tritium.

Barring dramatic breakthroughs, magnetic fusion is decades away from producing a practical commercial power plant. ICF is also far from practicality. In fact,

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**P***eaceful  
nuclear explosives  
would not be  
self-contained and  
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and so would  
be of little value  
to terrorists.*

the bulk of the funding for ICF comes from the defense side of the Energy Department—the principal use is to aid weapons designers by simulating thermonuclear explosions.

No doubt the idea of producing repetitive nuclear explosions sounds alarming. However, a PNE plant would actually be safer in some ways than today's fission plants, and it would be just as safe as one based on magnetic or inertial-confinement fusion. In fact, PNE has many of the strengths and weaknesses of all fusion schemes. And since PNE is possible in the relatively near term, it helps us think about fusion and compare it with fission in a realistic way. Also, PNE is not the terrorist's dream it might seem to be at first

blush. The explosives would not be self-contained and transportable. The fissile material would be no more vulnerable to diversion than the fuel transported to and from a reprocessing plant of the sort operated or planned by many countries that use fission power. (The United States has declared its intent to avoid reprocessing.)

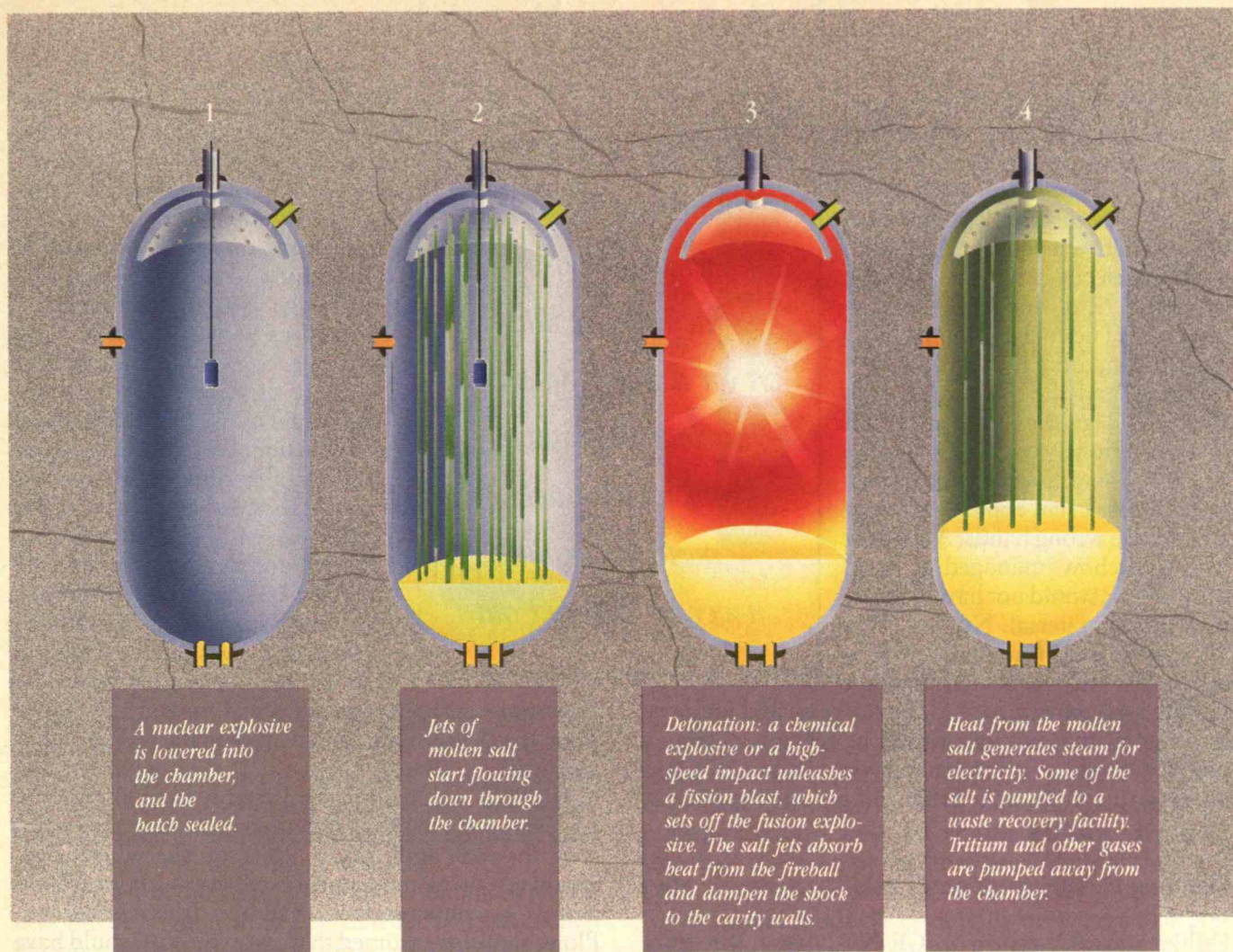
PNE is not a new idea. In the early 1960s, physicist Albert Latter, then of the Rand Corp., devised a scheme called Pacer, which also would have captured the heat of nuclear explosions to generate electricity. But Latter did not plan to reprocess the unburned fuel—a crucial step that we believe makes PNE economically credible. Also, Pacer assumed Hiroshima-sized twenty-kiloton explosions. We believe PNE could work with explosions of one or two kilotons.

Over the past decade, scientists at nuclear weapons laboratories have taken a second look at designs like Pacer. Their aim has not been to develop an energy-production technology but to create a laboratory for studying matter at high density, pressure and temperature. They called it the High Energy Density Facility. Many of the technical ideas in this article come from that study.

### Bombs into Energy

A PNE power plant would ignite nuclear explosives about every 20 minutes to produce 3,000 megawatts of thermal power. A generating plant would convert this heat into about 1,000 megawatts of electricity—the same output as a standard power plant based on coal or nuclear fission.

The cavity would have to be engineered to withstand the shock of the nuclear explosions. The elastic forces



in rock would cause it to ring like a bell when hit by an explosion; with repeated blasts, the rock would crack into rubble and eventually the cavity would collapse.

One solution would be to mine a cavity in hard rock and line it with a thin layer of steel. This steel would be attached tightly by bolts anchored deep in the rock. Rock has enormous mass and is strong under compression, and a steel liner would ensure that it would stay compressed. That would prevent it from cracking.

It is also essential to protect the walls of the vessel from the hot gases and intense radiation of the nuclear fireball. This could be accomplished by surrounding the explosives with jets of liquids—the same liquids that are then used to extract heat. The jets also dampen the impact of shock waves on the wall. Two materials have been considered: one based on water, the other molten salt (lithium beryllium fluoride, or  $\text{Li}_2\text{BeF}_4$ —called Flibe). The advantage of water is that it is cheap, while the advantage of molten salt is that more fission products are soluble in it, and fissile and fusile materials can be recovered relatively inexpensively.

To minimize the fission material needed—and thereby generate less radioactive waste—engineers could take an approach they've known about since 1943: increas-

ing the compression of the fission fuel. This way, both its mass and its yield can be lowered while the fraction that actually undergoes fission in the explosion goes up. These changes decrease the inventory of the fissile materials, make reprocessing cheaper, and reduce the cost of the containment vessel.

In nuclear weapons, conventional chemical explosives provide the force to compress the fission fuel, but PNE would probably use other means. One reason is that chemical explosives supply only so much pressure before even the hot gases they produce will condense. Moreover, if the materials being pushed accelerate to very high velocity, the hot gases cannot expand fast enough to "chase" them.

Several methods can deliver higher pressures than conventional explosives and also are capable of accelerating material to higher velocities. For example, engineers might wrap the fissile material in a cylindrical metal jacket through which they would pass a large electric current. The magnetic field generated by the current would produce a force that would squeeze the cylinder.

Or the PNE might contain one or two guns to hurl pieces of fissionable material at each other at speeds

**E***ach PNE  
plant, including  
reprocessing and  
waste disposal  
facilities, would  
sit on a highly guarded  
"nuclear reservation,"  
from which nuclear  
material would  
never be allowed out.*

three times that produced by high explosives. One possibility would be to use gas guns, which are similar to ordinary artillery but rely on compressed gases instead of gunpowder. An alternative would be a rail gun, in which electric currents induce a magnetic field that launches the projectile. The collision would compress the material into a supercritical state, and the resulting fission blast would ignite a fusion explosion in a deuterium-tritium fuel charge.

These compression schemes also lower the risk that explosives might fall into the wrong hands. A terrorist who somehow managed to steal from a PNE would not have a bomb, only bomb material. Nowhere in a PNE would one find fissile material conveniently packaged together with the machinery needed to compress and ignite it. In other words, nothing would be recognizable as a bomb. Gas guns and rail guns would be massive and bulky and totally unsuitable for producing nuclear weapons.

### Planning Development and Costs

Unlike magnetic fusion or ICF, PNE does not require solving any fundamental scientific problems. We envision an orderly sequence of engineering developments, starting with small facilities that could withstand explosions of 30 to 300 tons. These test facilities would verify PNE's key assumptions, such as the idea that the steel-lined cavity could take repeated nuclear blasts. Inspection of the chambers after each shot would show whether its radioactivity was in fact as low as predicted. In parallel, work would also go forward on improving the explosive.

The next step would be to build a cavity for testing explosions of one to two kilotons—the magnitude we consider useful for producing commercial power. Such a cavity would be the size of a sphere 60 meters in diameter—an underground bubble half a football field across and tall enough to hold a 20-story building. At this stage, automated plants would be built to manufacture fusion explosives and to reprocess unused nuclear material and separate wastes. This facility would probably be subject to international inspection, since it could produce nuclear materials. Successful operation would lead to the building of a full-scale power plant.

Despite its unconventional technology, a PNE could produce electricity at a cost comparable to that of today's baseload generating plants. We estimate that a

PNE power plant using one-kiloton explosives would be economically competitive at \$1,000 per explosion, which would include both producing the nuclear explosive and reprocessing the nuclear materials.

According to estimates made at Oak Ridge National Laboratory, reprocessing with a molten-salt system could cost as little as \$10 per kilogram of recovered uranium, which could translate into \$100–500 per explosion. Government secrecy makes a realistic and up-to-date estimate of the cost of manufacturing the nuclear explosive unavailable. The only one that exists was made some 30 years ago for Plowshare, a program to study peaceful uses for nuclear explosives, such as creating harbors and digging canals. The

Plowshare estimate was orders of magnitude higher than the \$500–900 that would make a PNE economical.

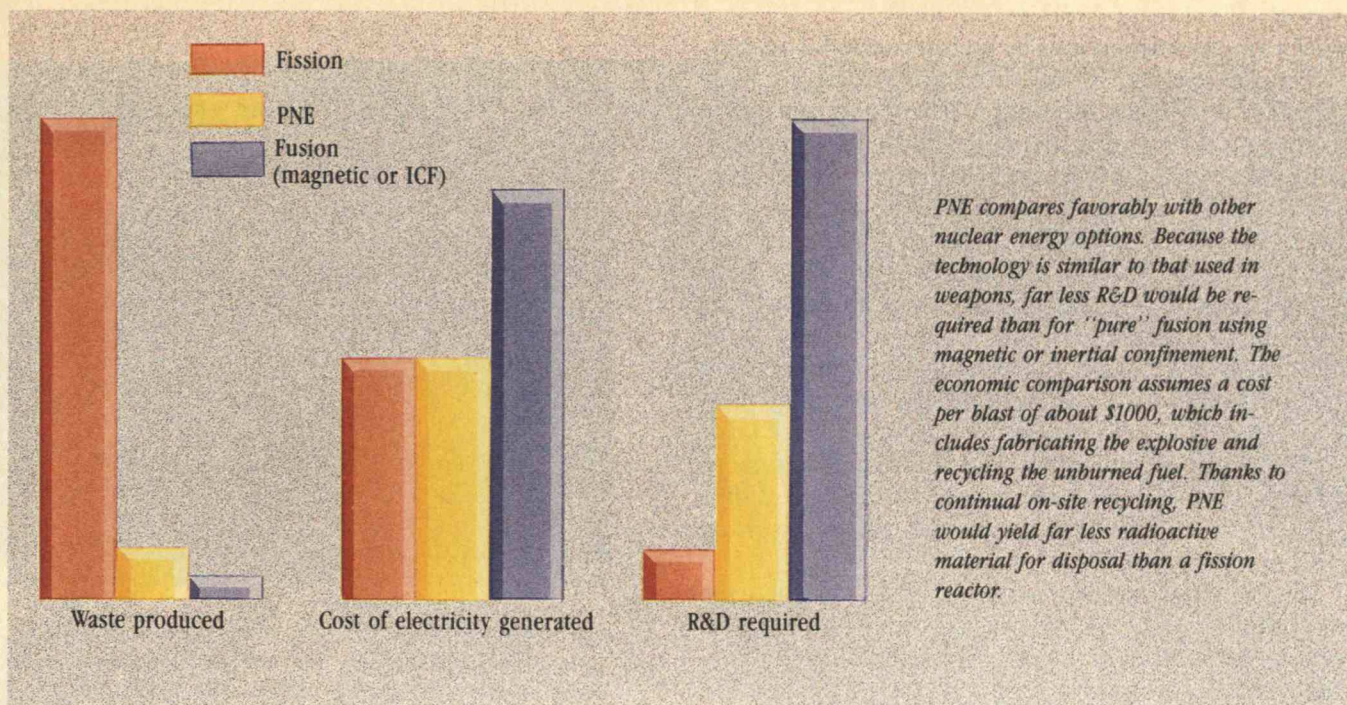
But PNE would differ significantly from Plowshare. For example, Plowshare required custom-made explosives for each application. PNE, on the other hand, would rely on many identical explosives—about 25,000 a year—so mass production should drive costs down. Plowshare also assumed that the explosive would have to be packaged for safe transport, and that there would be no recycling of fuel. Neither of these assumptions holds for PNE, which would therefore cost less.

The nuclear portion of the PNE electricity cost might be about half a cent per kilowatt-hour. Adding on the cost of the explosion cavity and conventional electrical generating machinery might bring the total to about four cents per kilowatt-hour—roughly what we now pay for electricity from a baseload generating plant using fission or coal. These estimates may be optimistic; we present them to show that the cost of electricity produced by a credible PNE station may well be competitive with ordinary electric power, even without extensive research efforts.

### In Case of Accident

We believe that a steel-lined chamber mined into hard rock could withstand repeated explosions of the magnitude a PNE would use. But accidents do happen. If interlocks failed and the molten salt jets were not flowing at the moment of explosion, for example, the shock would hit the cavity walls at full strength. What would happen if the walls cracked?

Because the cavity is underground, leakage would



be small; the debris would contaminate the nearby rock and be detected. To leak into the atmosphere, radioactivity would have to penetrate the steel lining of the cavity, many feet of earth, and sealed doors that would stand between all underground tunnels and the surface. Such a leak would be highly unlikely.

And if a leak did occur, the worst contamination from it would be no more than 1 percent of that from today's fission plants. The reason is that a PNE plant would contain far less waste. Fission products would be removed from a PNE's salt jets perhaps once a week; in a fission reactor, wastes build up for about three years. Moreover, the PNE plant could be completely shut down simply by not lowering the next explosive into the chamber. There could not be the kind of runaway fire that exacerbates radiation release in a fission-plant accident because molten salt does not burn. By contrast, the graphite in the Chernobyl reactor burned for days.

The location of the PNE would have to be chosen so that the chamber would be acceptable for on-site burial of wastes. This is necessary because although most of the fission products will be continuously removed for burial, some wastes would accumulate on the walls of the cavity. Decommissioning might mean filling the chamber and auxiliary excavations with rock and concrete.

Proponents of fail-safe fission plants, such as small, gas-cooled reactors, similarly promise that no leak of gas or fluid could release significant amounts of radiation. One advantage of PNE is that it would continuously remove fission products from the plant. Also, as the design evolves to diminish the required size of the fission explosive, it would produce diminishing amounts of waste.

A practical goal would be to reduce the fission yield to 10 percent of the total, thus cutting waste by a factor of 10 compared with an all-fission plant. If researchers could find a way to initiate the fusion explosion without fission, we would eliminate fission wastes altogether, leaving only fusion wastes. Careful choice of PNE materials could make these wastes small. Flibe, for example, produces essentially no wastes and prevents the walls from becoming radioactive.

Although PNE would produce relatively little waste directly, there is an important caveat. Fusion reactions produce large quantities of neutrons. These neutrons could be used to "breed" material—either plutonium or uranium-233—for fission reactors, which would then produce their own waste. Such breeding would require surrounding the fusion reactor by a blanket of uranium-238 or thorium-232, abundant isotopes that can be mined from the earth. Indeed, a PNE plant might generate as much income from selling plutonium to fission reactors as from selling electricity. The same possibility exists for any fusion technology, however. In fact, the incentive to use magnetic-confinement or inertial-confinement fusion plants as breeders would be even greater, because the costs of these facilities are expected to be high.

### Proliferating Plutonium?

The plutonium that could be produced in a fusion breeder is excellent bomb material. This is a problem that all fusion reactors will have to face, and that fusion advocates have spent years not talking about. To prevent plutonium breeding, a PNE—or any other kind of fusion plant—should be subject to thorough and in-

trusive on-site inspections by an international agency.

Fission reactors, by contrast, pose relatively little danger of weapons proliferation. These plants produce plutonium-239 in the spent fuel rods, but they also produce a lot of plutonium-238 and plutonium-240, which are not nearly as good for weapons. All three forms of plutonium are embedded in highly radioactive waste. It would be dangerous to steal the waste from a plant, and the bomb-grade plutonium would be difficult to separate.

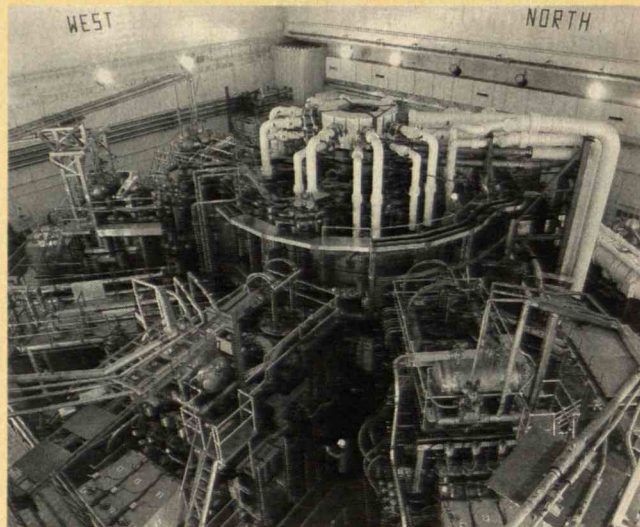
But many nations that use fission power are recycling the fuel or plan to do so. These countries—most notably France and Japan—recycle because they lack large supplies of uranium, and because separating the fissionable uranium-235 from the common uranium-238 is expensive. Unfortunately, recycling greatly raises the proliferation risk.

Spent fuel rods are sent to recycling plants, where the plutonium is separated and manufactured into new fuel rods, and it is difficult to detect if relatively small quantities of the plutonium have been stolen over a period of time. A malicious person or organization could accumulate enough to build a bomb. Thus, generating electricity with any kind of fission that depends on recycling poses just as much danger of weapons proliferation as fusion plants would if they were used to breed plutonium. Given the experience outside of the United States, it seems unrealistic to expect that operators of fission plants will agree to forego recycling.

Any nation that can design a PNE plant can produce nuclear bombs. For this reason, the international community should control the technology, permitting plants to be built only by states already possessing nuclear weapons or by non-weapons states under the supervision of an international agency. Any country that already has nuclear weapons would learn essentially nothing of military use from operating a PNE.

Proper siting and supervision of a PNE power plant would go a long way toward diminishing the admittedly serious problem of nuclear proliferation. Each PNE, including the power plant and the facilities for reprocessing and waste disposal, should be situated on a "nuclear reservation." To assure that no nuclear materials would ever be shipped out, these reservations would be extremely well guarded and located far from population centers, probably in deserts. Such siting would also address fears that a PNE accident might contaminate groundwater. Security at the gates of the reservation would have to be equivalent to that at a weapons facility.

One potential obstacle to PNE would be a tightening of the nuclear test-ban treaty. The treaty now observed (though never ratified) permits detonation of nuclear explosives up to 150 kilotons and so would allow a PNE plant of the type we propose. In fact, PNE could be developed and operated even if this threshold were lowered by an order of magnitude. But a compre-



*PNE represents a radical departure from mainstream fusion research. In the leading approach, a doughnut-shaped chamber called a tokamak, like the one at Princeton (above), produces specially shaped magnetic fields to contain the hot fusion plasma. In a competing method—inertial-confinement fusion (ICF)—intense laser*

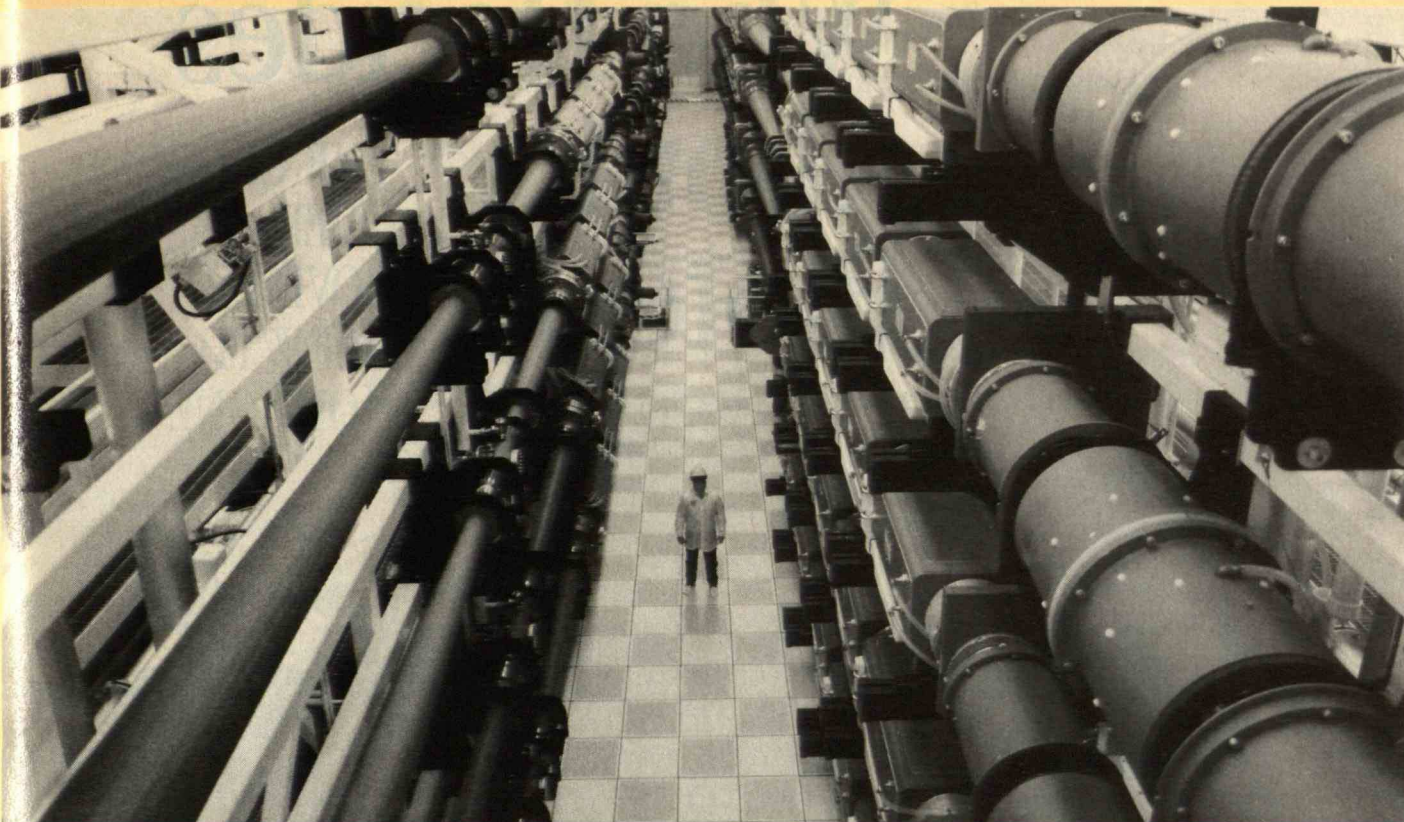
*beams heat and compress a tiny pellet of fusion fuel in an attempt to touch off a microscopic thermonuclear explosion. ICF requires enormous lasers such as those at Lawrence Livermore Lab (right). Both magnetic fusion and ICF are decades from practicality.*

hensive test-ban treaty, which would forbid all nuclear explosions regardless of size, would rule PNE out. We would hope that if such a treaty materialized, it would make exceptions for explosions used in PNE. This exception would be worth the intrusive verification that policing them would require.

### **Crazy? Consider the Alternatives**

Today no ideal energy source for generating base-load electric power is in sight. Fossil fuels produce carbon dioxide, which the accumulating weight of scientific evidence suggests contributes to dangerous global warming. Conservation and increased efficiency, though essential, will not be enough to meet the energy demands of the world's growing population, especially in developing nations. We will undoubtedly have to turn to energy sources that do not produce carbon dioxide. There are three: solar, fission, and fusion.

All these sources have serious problems. Solar advocates typically minimize the potential role of nuclear power, and vice versa. Solar power sources, particularly photovoltaic cells, are growing cheaper and more efficient, and may become useful for daytime peaking power. They remain unsuited for base-load power generation, however, because the intermittent nature of solar power has no evident solution. Rechargeable



batteries, for example, continue to be inefficient, expensive, and short-lived, and foreseeable improvements are modest. Mechanical forms of storage such as pumping water into reservoirs and draining it to generate power when needed waste much of the energy. Flywheel storage is efficient but expensive. Photovoltaic production of hydrogen is an expensive way to generate electric power, though it may eventually prove cheap enough for applications where the hydrogen can be used directly, as in motor vehicles.

Fission, too, has large problems. There could well be another catastrophic accident, such as the explosion, meltdown, and fire at Chernobyl. And although we conclude that waste can be handled safely, much of the public obviously disagrees. Also, if fission involves reprocessing—and given the experience outside of the United States, it seems naive not to assume this—then the danger that fuel will be diverted to make weapons remains.

The United States alone is putting some \$500 million a year into fusion research; worldwide spending amounts to three times this. In our opinion, PNE is by far the most practical route to fusion. Unlike other approaches, which require fundamental scientific advances, PNE is based on mature technology. For perhaps \$50-100 million a year, we could embark on a PNE program that would be highly likely to result

in an operating power plant decades before either magnetic or inertial-confinement fusion could.

Indeed, attempting to go straight to pure fusion would be as if James Watt had tried to build a steam turbine engine because it was thermodynamically more efficient and less polluting than a piston engine. But ordinary steam engines drove the industrial revolution, which eventually made turbines possible. Similarly, incremental development of PNE could lead to efficient fusion.

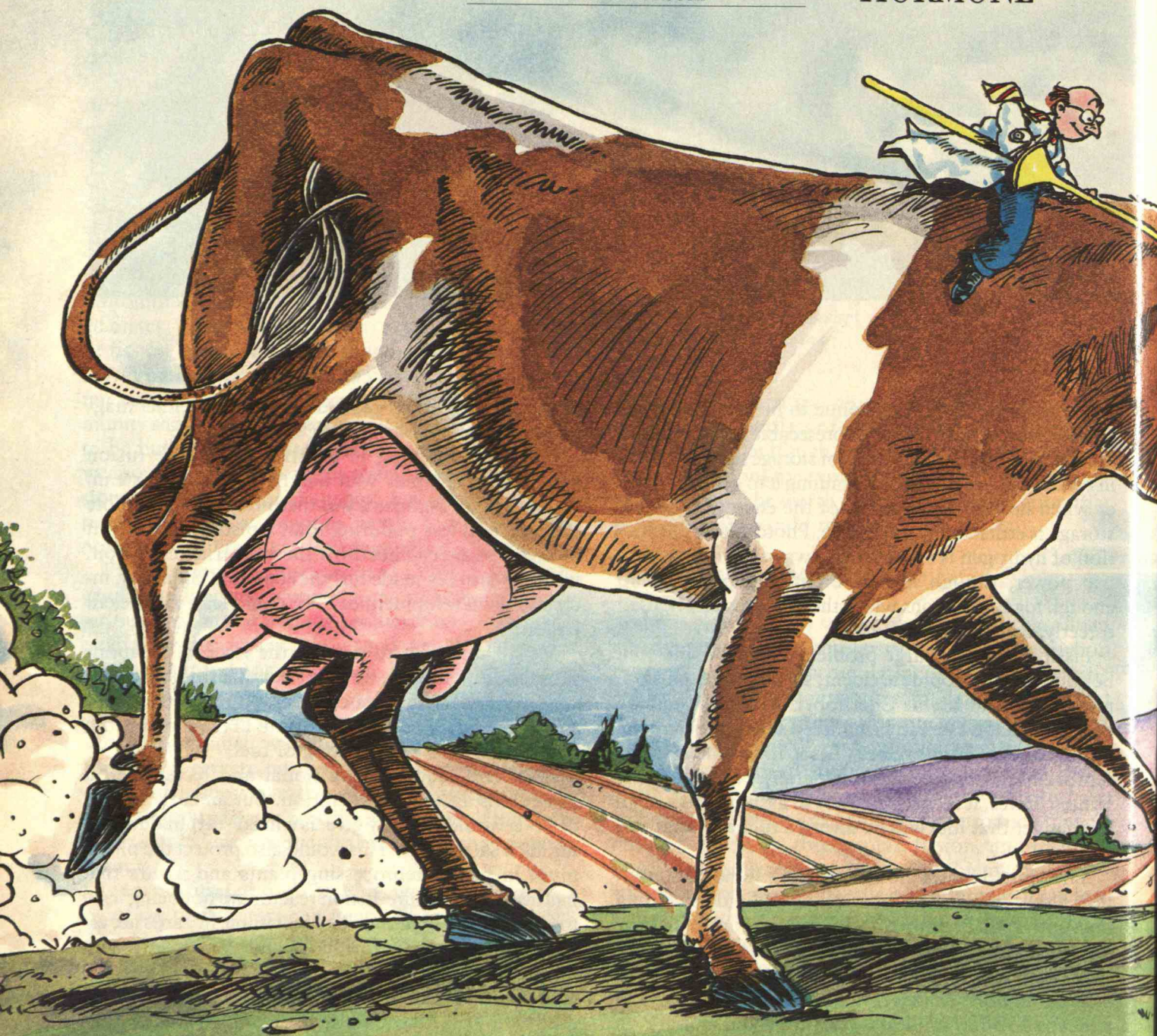
We do not wish to dismiss the issue of weapons proliferation. Rather, we point out that this same concern will arise with all nuclear technologies relevant to truly long-term energy production: PNE, pure fusion, and fission with reprocessing of fuel.

PNE will require institutional and technological safeguards against proliferation. But an early advent of PNE would actually give us a head start in developing such safeguards. This would also protect the plutonium in fission reprocessing plants and assure that neutrons from a pure-fusion reactor are not being used to breed bomb material. The inevitable hazards are essentially equivalent for PNE and for fission with reprocessing, and are quite similar to those of pure fusion. Since we cannot afford to forego nuclear energy entirely for the long term, then the sooner we put PNE in place, the more secure our energy future will be. ■

# Who Decides About Biotech?

THE CLASH  
OVER  
BOVINE  
GROWTH  
HORMONE

BY WADE ROUSH

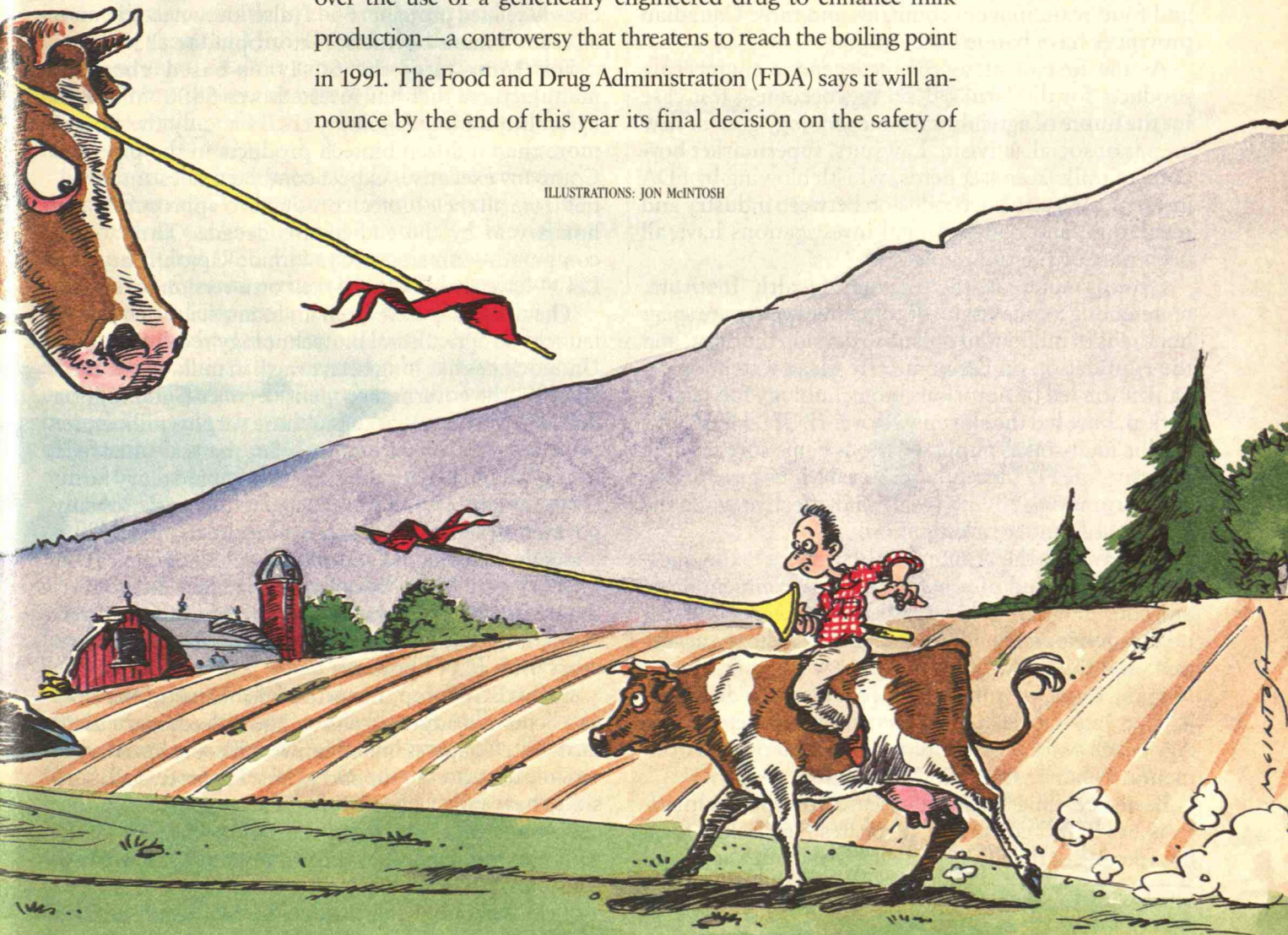


*Battles by consumer activists  
over the safety of the first agricultural biotech product  
may presage a new public involvement in science.*

ONE are the days when whole milk arrived in glass bottles on the doorsteps each morning and Elsie Borden served as spokesperson for an entire industry. Today sexy TV ads try to update milk's image, and supermarket shelves are crowded with 2 percent, 1 percent, nonfat, lactose-reduced, and other healthful permutations of the white liquid. But in American iconography, at least, milk still retains its traditional place as a symbol of childhood and purity.

This wholesome status is endangered by a seven-year controversy over the use of a genetically engineered drug to enhance milk production—a controversy that threatens to reach the boiling point in 1991. The Food and Drug Administration (FDA) says it will announce by the end of this year its final decision on the safety of

ILLUSTRATIONS: JON MCINTOSH



*Beneath the argument about risk is the question of  
what role farmers, environmentalists, and consumers are going to play  
in a process now dominated by industry, academia, and the FDA.*

injecting recombinant bovine growth hormone into dairy cows. The drug is a synthetic analog of a natural hormone that triggers milk production in cows' mammary glands. The four large chemical companies that want to sell their versions of rBGH claim it will make the dairy industry more efficient by boosting milk output 10 to 25 percent.

Small dairy farmers, environmentalists, and public-health experts fear the drug's introduction could wipe out many family-owned farms and pose myriad risks to both cows and humans. Opponents have introduced legislation in Minnesota and Wisconsin to extend existing bans on the commercial sale of rBGH milk, and they promise to organize a nationwide boycott of rBGH products if the FDA approves the drug. Health and safety questions have also prompted the European Common Market to declare a moratorium on rBGH use, and four Scandinavian countries and three Canadian provinces have banned the drug.

As the first of many planned genetic engineering products for the farm, rBGH has become a test case for the future of agricultural biotechnology and for new arenas of social activism. Lawsuits, supermarket boycotts of milk from test herds, whistleblowing by FDA insiders, allegations of collusion between industry and regulators, and congressional investigations have all been part of the tumult.

Groups such as the Animal Health Institute, representing a consortium of companies who have spent hundreds of millions of dollars to develop the drug, and the Foundation on Economic Trends, a watchdog organization led by notorious biotechnology foe Jeremy Rifkin, have led the skirmishes over rBGH. Highlighting the high-stakes public-relations game surrounding the issue, the FDA recently chastised Monsanto for illegally promoting rBGH as safe and effective while the drug is still under investigation.

Underneath the argument about risks is the question of what kind of role farmers, environmentalists, and consumers are going to play in a process of biotechnology development now dominated by industry, academia, and the FDA. "This technology is racing ahead, in many cases, of our social mechanisms to deal with it," says Jack Doyle, a leading critic and director of the Agriculture and Biotechnology Project at the Environmental Policy Institute in Washington.

Besides calling for more research on the health effects of rBGH, consumer advocates have asked for a broadening of the FDA's mandate to include social and

economic effects in its drug review process. Activists are also fighting for greater public involvement in setting the R&D agenda. "In the U.S. system the average person has no say in the development of technology or the development of products," says Michael Hansen, an analyst for Consumers Union. "They can only get their say by veto power—I will buy it or I will not buy it—and that's not public participation."

### **Anatomy of a Controversy**

Genentech scientists, with backing from Monsanto, first isolated the gene responsible for the production of natural BGH in cows' pituitary glands in the late 1970s. Using standard genetic-engineering techniques, they duplicated and spliced the gene into the DNA of *E. coli* bacteria, which then secreted huge doses of a closely related protein, rBGH (also known to scientists as recombinant bovine somatotropin, or rBST).

For Monsanto, the St. Louis-based chemical manufacturer that has invested over \$800 million in agricultural biotechnology, rBGH is only the first of more than a dozen biotech products in the pipeline. Company executives expect combined sales and royalties from all their biotech products to approach \$1 billion a year by the end of this decade. Three other companies—American Cyanamid, Upjohn, and Eli Lilly—have also developed their own versions of rBGH.

The drug may have been an inauspicious choice to launch the agricultural biotechnology revolution. The United States has long been awash in milk. From 1987 to 1989, the government spent between \$600 million and \$1.3 billion a year to purchase surplus milk under price-support legislation. In 1986, the year after field tests of rBGH began, the government paid dairy farmers to slaughter 1 million cows to reduce milk subsidy payments then costing taxpayers more than \$1 billion annually. Hansen, of Consumers Union, calculates that if rBGH were widely adopted and farmers did not further reduce herd sizes, an added milk surplus of 10 percent could cost taxpayers \$1.8 billion in the first two years after FDA approval.

Early rBGH proponents touted cheaper milk prices as a benefit of larger surpluses, and indeed, in the 1990 farm bill, Congress linked future milk surpluses to automatic decreases in support prices. However, such subsidies have fallen since 1985 without a corresponding cut in supermarket prices—the average price of a half-gallon of whole milk rose from \$1.11 in 1986 to \$1.43 last year.

If rBGH holds out little promise of direct benefit to consumers, proponents still say it will make dairy farms

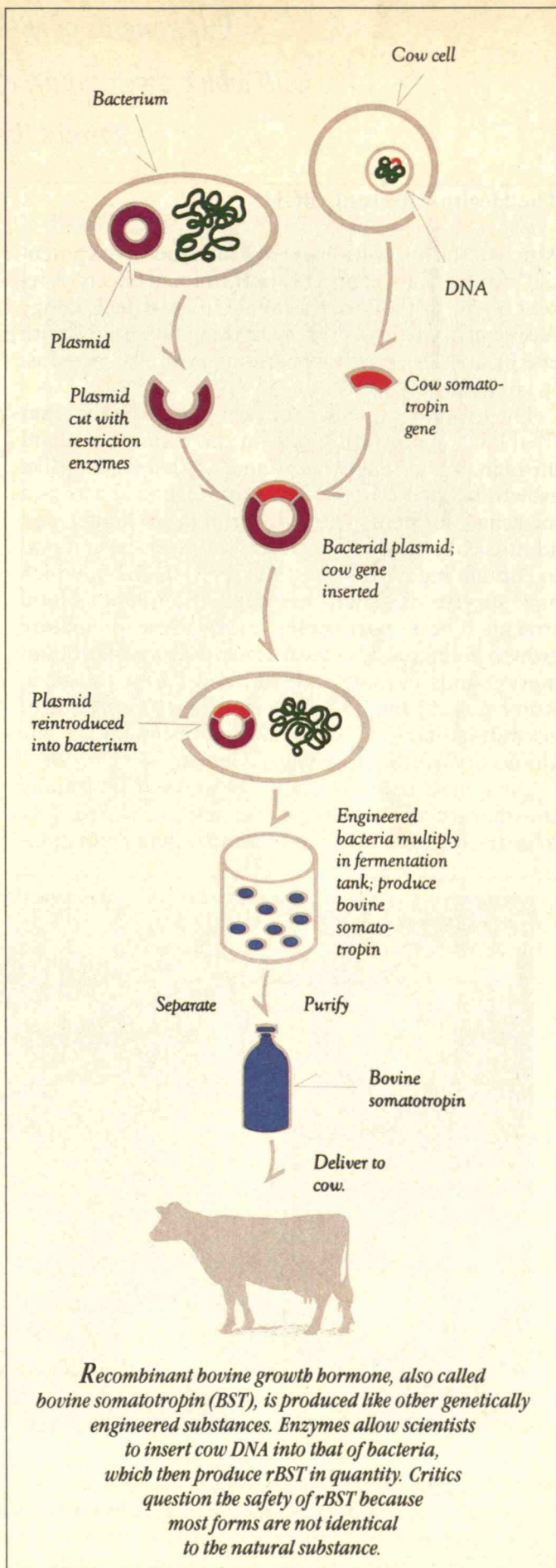
WADE ROUSH is a doctoral candidate in MIT's Program in Science, Technology, and Society. A Technology Review intern, he wrote "Science and Technology in the 101st Congress" (TR November/December 1990).

more efficient by redirecting the nutrients a cow eats from other physiological functions to milk production. To achieve the full effect, farmers must feed cows more and higher-quality grain, and the injections themselves will cost between 25 and 75 cents per day per cow. But Monsanto claims that the value of the extra milk will be more than twice the combined cost for feed and rBGH treatment.

Opponents don't dispute these figures, but they point to predictions that the new technology will favor factory farms with greater economies of scale and more sophisticated herd management. These large-scale operators will be better able to computerize their operations to balance drug dose with feed requirements to maximize the yield from each cow. A 1985 study by Cornell researchers indicated that rBGH use would exacerbate the existing trend toward fewer, larger dairy farms centered mainly in the Southwest and California rather than the Midwest and Northeast. Some 17 to 20 percent of all dairy farmers would go out of business anyway, the researchers found, but the adoption of rBGH could push another 10 percent out of the market.

Other studies have predicted little or no economic impact from rBGH, but anger over the social disruption the drug could cause inspired the first formal assault against it in 1986. Farm groups, environmentalists, and animal-rightists petitioned the FDA to prepare an environmental impact statement considering the possibility that "entire dairy communities could well be economically and socially devastated by the widespread use of BGH." Jeremy Rifkin, already the *bete noire* of biotechnologists for his efforts to prevent the release of genetically engineered organisms such as the ice-minus bacteria, organized the unusual coalition.

Though the FDA rejected the petition, the activities of Rifkin and the coalition continued as questions about the safety of rBGH began to emerge. In August 1989, responding to a letter from Rifkin, five large supermarket chains announced they would no longer allow milk from test herds to be used in dairy products carrying their stores' brand names. (The FDA has allowed the sale of such milk since 1984, when it determined from several early studies that the milk was "safe for human consumption.") At the same time, Ben & Jerry's became the first large U.S. food company to campaign actively against rBGH, labeling its ice cream cartons with a call to "Save family farms—No BGH." By the end of 1989, pressure from consumers, farmers, and other rBGH opponents had forced more than two dozen food companies, supermarket chains, and dairy co-ops to pledge bans on rBGH milk.



*Opponents of rBGH decry the secrecy  
with which the companies and the FDA continue to  
shroud their studies.*

### The Health Effects of rBGH

Much of the opposition to rBGH centers on its potential health effects, especially its hormonal effects. A recent report by the congressional Office of Technology Assessment dismissed many of these potential health effects, but the report's conclusions are unlikely to satisfy rBGH critics.

The greatest cause for concern lies in the fact that rBGH acts on lactating cells in the mammary gland through a messenger substance called insulin-like growth factor-1 (IGF-1). The same chemical acts as a messenger for human growth hormone in children and adults. Milk from rBGH-treated cows has been found to contain higher-than-normal levels of IGF-1, which may survive digestion and enter the human blood stream. These extra doses could cause premature growth in infants, excessive development of the mammary glands in male children, and breast cancer in women, according to Samuel Epstein, a professor of environmental and occupational medicine at the University of Illinois Medical Center.

Data on drugs undergoing FDA review are usually considered confidential, but in an unprecedented move to quell controversy over IGF-1 and other health ques-

tions, the FDA published some results from industry studies in the August 1990 issue of *Science*. FDA researchers Judith Juskevich and Greg Guyer concluded that milk from rBGH-treated cows did show IGF-1 levels at least 25 percent above average. However, they maintained that studies in rats show the substance is broken down in the digestive tract, and therefore could not cause any important physiological effects.

Hansen, in a report for Consumers Union, criticizes the *Science* paper for referring to a number of unpublished industry-funded studies without revealing their results for full inspection. He also notes that research has recently shown that the most common methods for measuring IGF-1 levels in milk produce falsely low results, and that the rats were fed "free" IGF-1 not bound to the normal carrier proteins that might help it survive digestion. Epstein points out that the key reviewer of the *Science* article was Dale Baumann of Cornell University, a major contractee and consultant to Monsanto on rBGH for the last decade.

Allegations of overly close cooperation between the chemical companies and the FDA have surfaced throughout this controversy. The agency fired Richard Burroughs, the veterinarian in charge of its rBGH review from 1985 to 1988, in November 1989, allegedly

because of incompetence. Burroughs says he was pushed out because he pointed to important flaws in the companies' safety studies that his superiors had overlooked in their eagerness to approve rBGH. "It used to be that we had a review process at the Food and Drug Administration. Now we have an approval process," he said last year. Burroughs is suing for reinstatement, and on the advice of his lawyer will no longer comment on rBGH.

Critics have raised the possibility that rBGH itself may have undesirable health effects. Juskevich and Guyer assert in their paper that natural BGH is inactive in humans, that rBGH is functionally indistinguishable from its natural counterpart, and that the human body breaks down rBGH in the digestive tract. Hansen and Epstein challenge each of these points.



*Monitoring the doses of extra feed and the costs of rBGH injections and grain requires sophisticated herd management techniques. Small farmers fear that widespread use of rBGH will favor large-scale factory farms.*

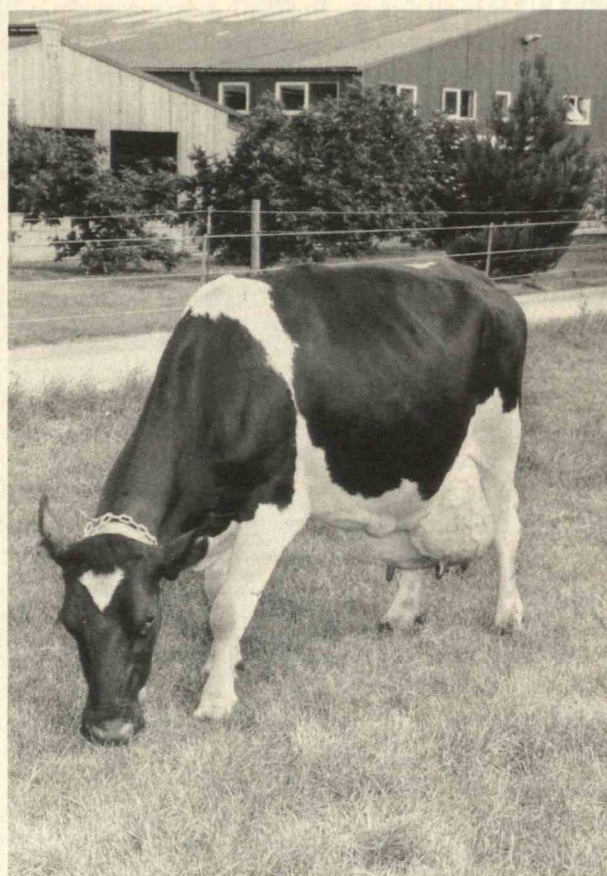
Epstein notes that the finding that BGH is not active in humans was based on studies of human dwarfism in the 1950s. But these same studies showed that human growth hormone was also ineffective unless accompanied by sex hormones such as androgen. Hansen also cites two studies showing that partially digested BGH, fragments of which are similar to HGH, are active in humans, causing the body to retain nitrogen rather than excrete it. Nitrogen retention is one measure of growth hormone activity.

Furthermore, only Upjohn's version of rBGH is identical to natural BGH in its amino-acid sequence; the others vary by up to 9 amino acids out of 191. The FDA has not made public any information to support its claim that these molecular differences do not cause functional differences. In fact, tests of a recombinant version of HGH now marketed by Eli Lilly showed that adding a few amino acids to the natural sequence provokes allergic reactions in some people. Finally, no method is available to distinguish between the natural and synthetic hormones in milk or blood, so it's impossible to say how much rBGH consumers will ingest.

A panel convened by the National Institutes of Health at congressional request concluded last December that milk from rBGH-treated cows is safe for human consumption. But Epstein charges that the panel's endorsement was a "naive whitewash" because it did not consider the confidential results from the companies' studies. He calls the efforts of NIH, FDA, and the chemical companies to silence questions about health risks a "criminal conspiracy." Other rBGH opponents have decried the secrecy with which the companies and the FDA continue to shroud their studies. "The *Science* publication raised a lot of questions. People aren't satisfied with what's been released," says Nachama Wilker, director of the Boston-based Council for Responsible Genetics, a nonprofit group critical of the biotech industry.

One final casualty of rBGH may be the cows themselves. Letters from the FDA in 1988 informed Monsanto and Eli Lilly that the agency was worried about a high incidence of udder infections in heifers under study. The letter to Monsanto also pointed to welts and "tissue reactions" around rBGH injection sites. At the doses for which the company was seeking approval, the letter said, the level of tissue reaction was "unacceptable" and might force meatpackers to trim the cows' carcasses. (Monsanto has threatened to sue publications that quote these documents, which FDA insiders leaked to activists.)

Proof of animal safety, a major requirement for approval of new animal drugs, is closely linked to ques-



*Effects on human health from rBGH are not the only issue: the FDA is concerned about a high incidence of udder infections and welts in cows receiving injections.*

tions of human health effects. Epstein charges that the higher metabolism induced by rBGH may stress cows' immune systems. Cows must already be treated with high levels of antibiotics to combat udder infections from rBGH, thus raising the level of antibiotics that remain in their milk. But public-health activists have long argued that chronic human exposure to antibiotics can reduce their effectiveness in combatting infection. "You can't make a decision on human health concerns unless you're sure there's going to be no increase in antibiotic use," says Hansen.

### The Public-Relations Battlefield

As questions persist about the health effects of rBGH and the FDA's handling of the approval process, chemical companies and the dairy industry fear a consumer backlash against milk "tainted with hormones." Indeed,

if the FDA does approve the drug, consumers may well be the ultimate arbiters of the dispute as they are forced to decide whether to buy rBGH dairy products. The various protagonists are therefore waging a high-stakes competition to win the hearts and minds of the public.

Representatives of the biotechnology industry face the challenge of overcoming consumers' concerns about chemicals, hormones, food additives, and genetic engineering in general. "Few things could be less welcome in milk" than hormones, a 1986 study commissioned by the National Dairy Board ruefully acknowledged. The board, an organization set up by Congress to promote milk consumption to which all dairy farmers must contribute, has attempted to play down the identity of rBGH as a hormone, preferring to call it a protein. (It is both.) The report, which spoke of "points of vulnerability" and "prepared defenses" to the "lines of attack" of advocacy groups, offered a militant response: a campaign by credible authorities to convince consumers that milk from rBGH-treated cows is identical to that from untreated cows. The Dairy Board named pediatricians and university scientists as the most persuasive individuals to attest to rBGH safety.

The chemical and dairy industry's battle plans reflect strategies common among businesses wanting to minimize public outcry over risks to health and welfare. One strategy is to put a reassuring message in the mouth of a credible authority—in this case, someone not obviously connected to biotech companies, the dairy industry, or the FDA.

Another method is to convince consumers that the risks imposed by the new technology are no greater than those they already tolerate. "You've had BST and cookies all your life," reads the headline of one advertisement co-sponsored by Eli Lilly, Monsanto, and Upjohn. Such statements omit doubts such as Hansen's and Epstein's about whether natural and synthetic BGH produce identical effects.

Biotechnology executives exasperated by the resistance to rBGH have also called for better public education on scientific matters. The debate over the drug's safety is "the result of living in a society that's relatively scientifically illiterate," Jerry Caulder, president of the Industrial Biotechnology Association, told a *Science* reporter. Ironically, greater understanding of the scientific dispute surrounding rBGH could lead to even more skepticism about the drug. And anti-rBGH activists decry Caulder's implicit assumption that social, economic, and emotional grounds for deciding on the wisdom of using the hormone are irrational. "It's certainly a worthwhile goal to increase scientific literacy in our society," says Wilker of the Council for

Responsible Genetics. "However, I think that's a smokescreen used to disguise other questions" such as those concerning the drug's social effects.

After public relations and pedagogy, the last refuge of rBGH proponents has been their call to let farmers decide whether to use rBGH. "If the product has no redeeming value, the market will tell us that," insists Laurence O'Neill, public-relations manager for Monsanto's agricultural division. The chemical industry is betting that dairy farmers will be forced to adopt rBGH to stay competitive. However, consumers voting with their shopping carts could well influence farmers' decisions. Several surveys show that customers would be willing to pay higher prices for milk from untreated cows—providing an incentive to farmers who *don't* use the drug.

Consumer and other advocacy groups have organized to thwart the industry's campaign at every step, especially by spreading their own brand of scientific literacy to farmers and consumers through newsletters and workshops. "You have to work for making scientific information accessible to people," says Wilker. "Then you have to open up mechanisms for those who want to participate in the discussion. And that's where [state] moratoriums come up. They are a dramatic response to the fact that there is no mechanism for the consumer to talk to the FDA."

Opponents of rBGH received unexpected support early this year when Gerald Guest, director of the FDA's Center for Veterinary Medicine, charged that many of Monsanto's public statements on rBGH constituted illegal promotion of an unapproved drug. Guest found that statements such as "If a cow is given extra BST, the milk doesn't change, but the cow is able to make milk more efficiently" create "the distinct impression that BST is safe and/or effective." Guest warned that continued premature promotion might prompt his agency to decide to reject Monsanto's application for approving rBGH.

Monsanto officials agreed to comply with the order, but O'Neill protested in the *New York Times* that "as a matter of fundamental fairness we have to have the ability to counteract this orchestrated campaign of misinformation that opponents of BST have been carrying on for several years. They can say or do whatever they want."

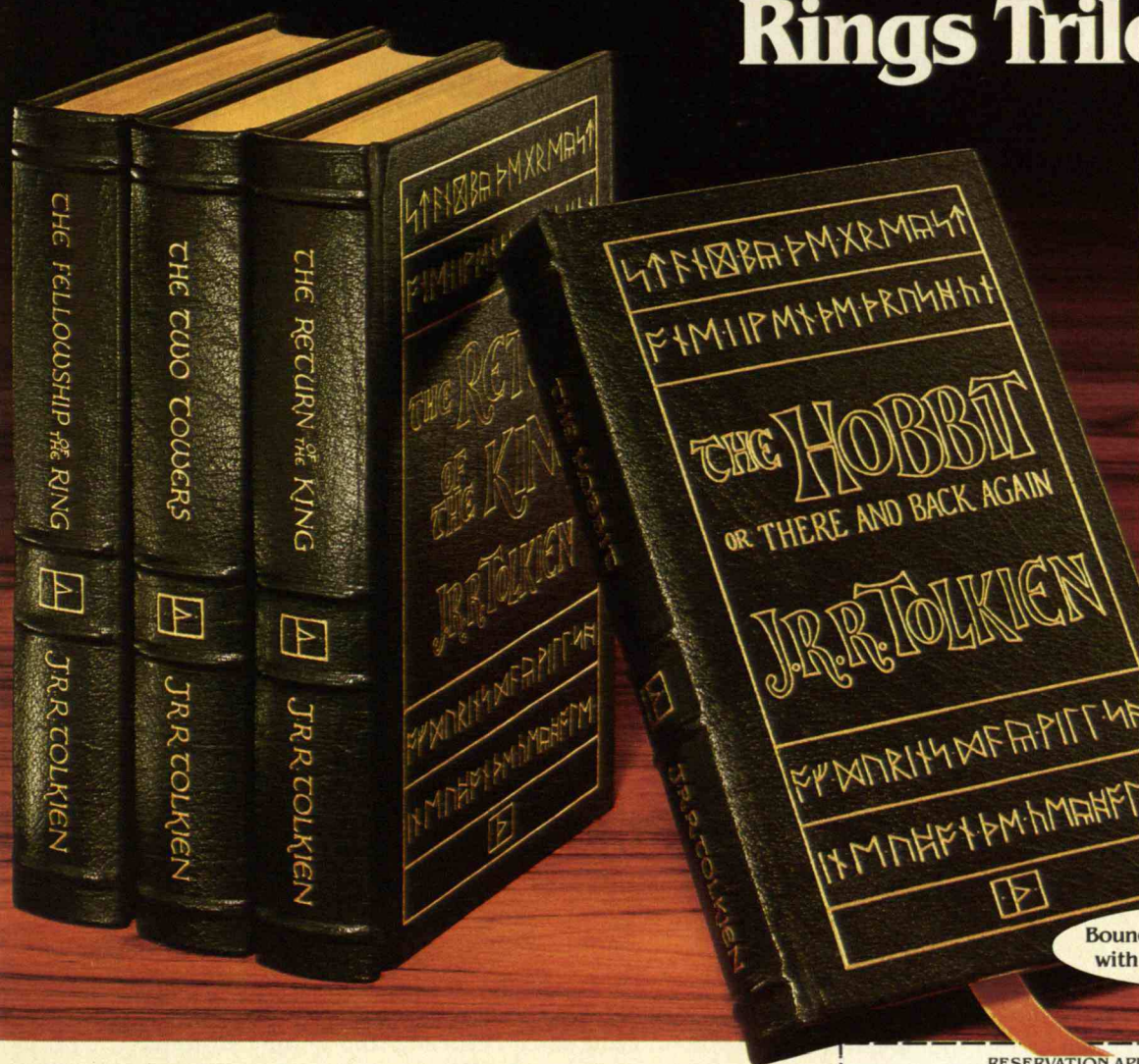
## Technology and Democracy

The recent OTA report criticizes chemical companies' decision to pursue rBGH as the first major biotech product for agriculture, and suggests that funding agencies and

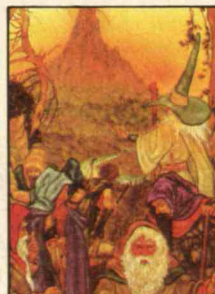
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*A 'fourth burdle'  
in the FDA's  
approval process  
would consider  
a new product's  
social and  
economic effects  
along with  
its safety,  
efficacy,  
and quality.*



industrial leaders do a better job of setting R&D priorities. Anti-rBGH activists add that members of the lay public must also be involved in this process. While their immediate goal is to prevent widespread use of rBGH, their effort is fueled by an underlying belief in the public's right to participate in technological decision making.

This March, rBGH opponents in Wisconsin, Minnesota, and the Dakotas initiated an experiment in such democratic involvement. The Northern Tier Cooperative Land Grant Accountability Project brings together concerned citizens and faculty members to discuss the merits of biotech projects at state universities, which have a mandate to serve the public. At the top of the agenda is whether the techniques that result from such research will contribute to "sustainable" agricultural practices that require fewer chemical pesticides and fertilizers, animal pharmaceuticals, and costly feed.

Margo Stark of the Minnesota Food Association, a group representing consumers and farmers that helped enact Minnesota's moratorium on rBGH, calls the project an effort to "reintroduce a notion of public contribution to the research agenda." By involving laypeople at the beginning of the publicly funded R&D process, Stark and others hope to abort inappropriate technologies and products before they acquire too much momentum.

Activists such as Stark challenge the assumption of the university and corporate worlds that science can produce definitive evaluations of the safety and need for a new technology. "What they fail to address in the

assertion that 'all policy should be science-based' is the fact that we have to make public policy choices based on a certain amount of ignorance on everybody's part, including the scientists," says Stark. "How we want to proceed in the face of unknown risk, such as in the case of rBGH, really becomes a matter for democratic policymaking."

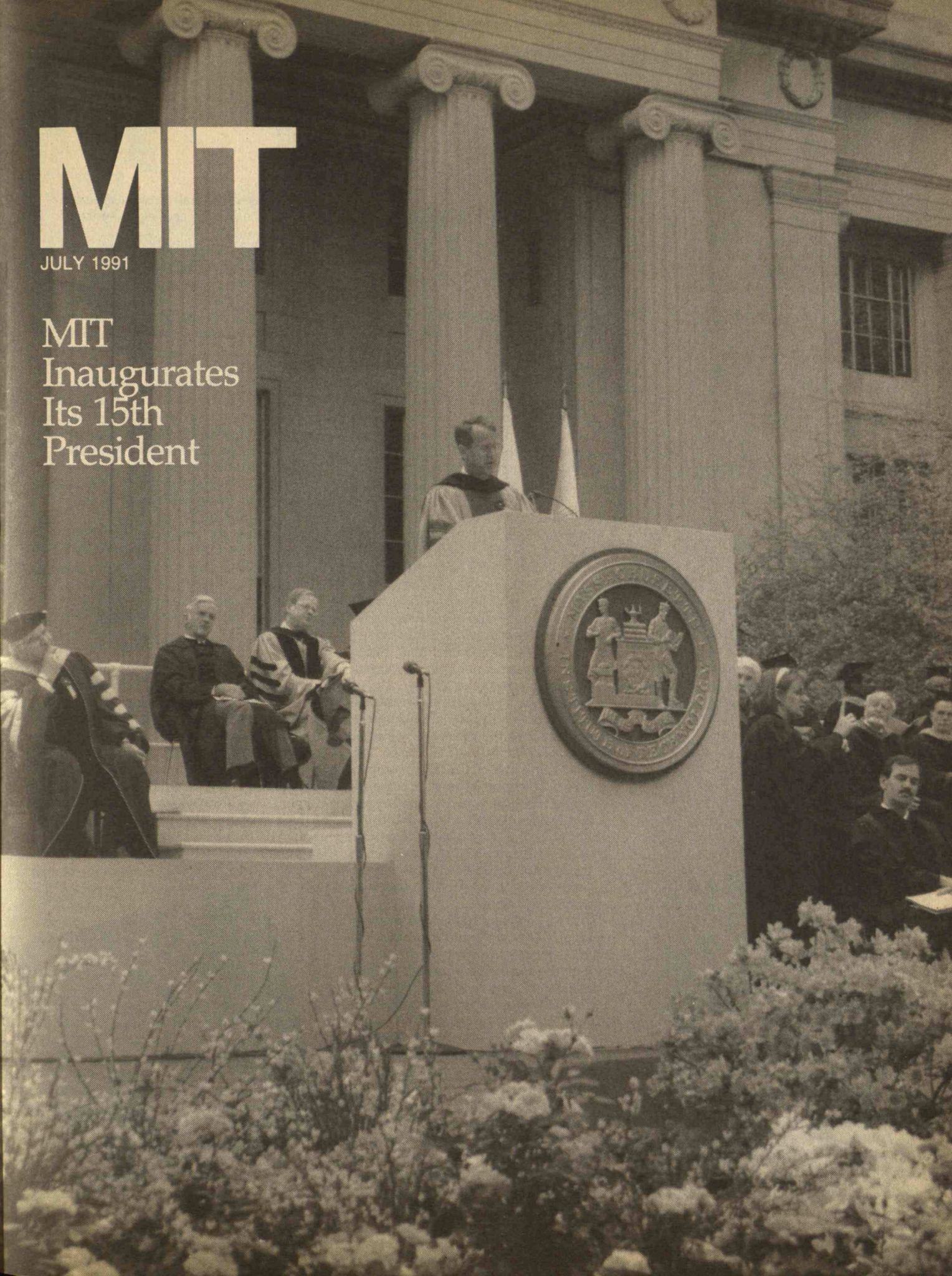
One way to enhance the biotech industry's public accountability, these critics suggest, would be to add a "fourth hurdle" to the FDA's approval process: considering a new product's social and economic effects as well as its safety, efficacy, and quality. Though the public would not be directly involved in such analysis, the FDA would have to take its concerns into account. Ray McSharry, commissioner of agriculture for the European Community, proposed just such a change for Europe in 1989 when he announced the EC's moratorium on rBGH. And a recent European Court decision upheld the power of the agriculture commission to ban steroids in meat solely on the basis of public opposition, even without scientific grounds for concern.

While the ultimate fate of rBGH remains cloudy, the drug will not be the last genetically engineered product to provoke calls for redefining and improving representation of the public interest. The network of biotechnology critics that formed around rBGH will continue to be a powerful force as more drugs and techniques emerge from the nation's laboratories. "I think that in a way we're all going to school on BGH," says Stark. "We're learning a lot about the questions that will need to be asked every time." ■

# MIT

JULY 1991

## MIT Inaugurates Its 15th President



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On May 10, Charles M. Vest stepped up to a podium that will become very familiar as the years go by, to set the themes and priorities that he expects to dominate his administration. Technology Review will report in detail on his address in the August/September issue. The colorful pageant include (from left) Chair of the Corporation Paul Gray, '54, President of Harvard Derek Bok, and President of the University of Michigan James Duderstadt. Photo by J.D. Sloan



## Campus Humor Exhibit and Book Hit a Funny Bone

Apparently, people find the idea of humor at MIT funny. How else to explain all the media attention garnered by an exhibit on campus humor and a recent book on MIT pranks?

The exhibit, which runs through September 13 in Compton Gallery, features such prized possessions as the mysterious MIT balloon that disrupted the 1982 Harvard-Yale football game and the life-sized steer, courtesy of Hilltop Steakhouse, that once adorned the top of the great dome.

Warren Seamans, director of the MIT Museum, knew the displays were worth a few chuckles for those around campus, and he figured high school students visiting this summer could see a different side of the Institute. But he never thought the *Today* show's Gene Shalit would come calling, along with National Public Radio, *Newsweek* magazine, newspapers, and the local television stations.

In retrospect, though, Seamans says he should have seen the onslaught coming. Last year, when the museum published *The Journal of the Institute for Hacks, Tomfoolery & Pranks at MIT* (IHFTP) a compendium of student pranks over the years, the Associated Press jumped on the story and others followed. Without any advertising, the book has almost sold out its first printing of 4,500 through single-copy sales by the museum. One publisher has requested Japanese rights; another wants to reprint it altogether.

Both the book and the exhibit focus on hacking, MIT's own brand of pranks. The exhibit set out to cover all of humor through the ages on campus, but "humor changes very rapidly," says Seamans. "Stuff that was funny in the '20s, even the '60s and '70s, isn't funny now, or it's embarrassing or illegal"—the earlier stuff was full of "isms," the later stuff full of references to drugs. The stunts that remain timeless, then, are the clever tweaks at campus life: the dorm room reconstructed on the Charles River, the authentically rendered "NERD XING" traffic sign, the cafeteria tray and place setting sneaked into a contemporary art exhibit—as its sign

read, "The sterile lateralism of the grouped utensils (sans knife) conveys a sense of eternal ennui. . . ."

Until now, these pranks have been just the stuff of folklore. The stories are passed down to each successive class as early as the first week of school, when upperclassmen recount their fraternities' or dorms' best hacks in the course of recruiting freshmen. Lambda Chi, for instance, takes credit for the Smoot measurement of the Harvard (Mass. Ave.) Bridge, ATO for the Harvard-Yale game balloon. And decades after graduation, the tales still get told. Seamans ends each of his talks to alumni clubs on a light note, showing a few slides of infamous hacks. "We can spend another two hours," he says, "having people tell their version of the incident, or about something they did."

The fact that this folklore is now being shared with the public can only help MIT, Seamans says. As he told reporters this spring, "The Institute has a cold, monolithic image. We're trying to show its human side."

While some of the media attention has focused on the supposed irony of engineers having a sense of humor, other accounts have shown an appreciation for the clever scheming and skillful execution.

*Newsweek* went a step further. In an April 15 story ("Revenge of the Slide Rulers"), the magazine pointed a finger at Harvard by comparing the Crimson's "sophomoric humor" to MIT's "ingenious" hacks: "At Harvard, they always seem to be laughing at the rest of the world. The nice thing about MIT humor is that they're usually laughing at themselves." □



The future Building 68



## Ground Broken for Biology Building

Ground was broken this spring on east campus for a six-story building to house the Biology Department. Located at the corner of Ames and Main streets, the building is expected to be completed in the fall of 1993.

The \$70 million facility represents a "major commitment to the life sciences by MIT," said Provost Mark Wrighton. It is the first academic building to be constructed on campus since 1982.

Plans drawn by architects Goody, Clancy and Associates call for a building 360 feet long with 142,000 net usable feet of space. Facilities will include 32 groups of laboratories, a research library and reading room, a seminar hall that seats 150, and lounges and common rooms for researchers. The design of such spaces aims "to foster collegiality and cooperation among research scientists, an essential feature of scientific discovery," said Wrighton.

A 1986 visiting committee cited inadequate physical facilities as one reason for poor recruitment and retainment of junior faculty in the Biology Department. In 1990,

Biology Department Head Richard Hynes, PhD '71, told a visiting committee, "The proposed building has already made a major difference in our recruitment of faculty."

The biology complex is the only building included in MIT's *Campaign for the future* fundraising appeal. Once the new facility is completed, renovation will begin on the nearby Whitaker (Bldg. 56) and Dorrance (Bldg. 16) buildings, which presently house the Center for Life Sciences. A bridge and two tunnels will link the new building with Buildings 66 and E17.—Lisa Watts □

## A New Branch Office in D.C.

In an effort to enhance MIT's relations with federal policymakers, the Institute plans to open a Washington, D.C., office this summer. Directing the office will be John C. Crowley, who as a vice-president of the Association of American Universities has specialized in federal relations in the areas of scientific research and advanced education.

President Charles Vest says Crowley will concentrate on reaching out to members of the federal legislative and executive branches to find out where and how MIT can help on science policy issues, particularly in the areas of astronomy, engineering, and materials science.

Ronald P. Suduiko, assistant to the president for government and community relations, says Crowley will provide two-way communication for the Institute. "We want to continue the communications we've had in Washington over policy issues on science, research, and education," he says. "We can be seen as a resource. Vest has heard this since he started here. Also, we can communicate [the latest developments in Washington] to the people back on campus."

Vest told *Technology Review* (May/June) that he intended to be much more aggressive "in telling the MIT story in Washington and having a strong presence there." Crowley began spending one day each week on campus in the spring. He will begin working full time in August, when the Washington office opens.

Other universities with offices or a representative based in D.C. include the University of Michigan, Princeton, and numerous California schools. □



## ALUM NEWS

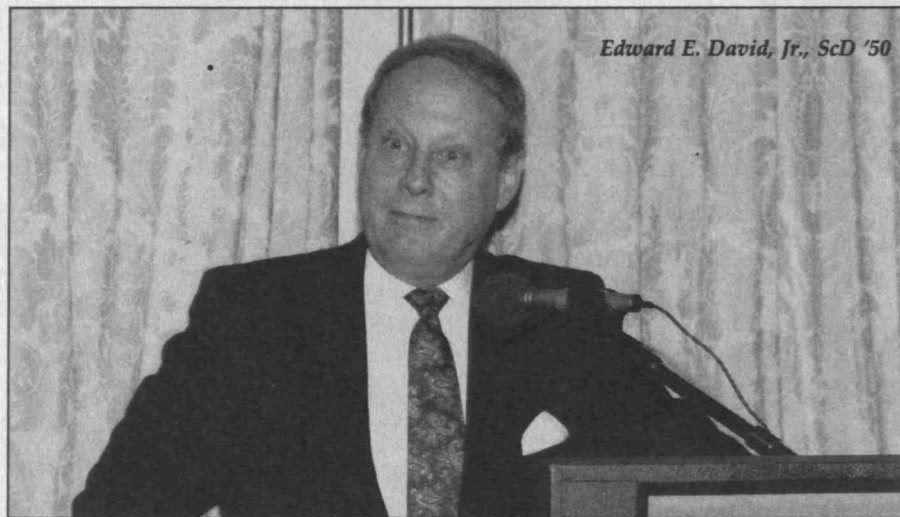
### Silver Stein Award to Ed David

The MIT Alumni Center of New York presented its Silver Stein Award for 1991 to Edward E. David, Jr., ScD '50, in a ceremony at the Lotos Club in March. The Silver Stein is given biennially to a member who has made a major contribution to his or her profession.

A private consultant on research and innovation since 1986, David has led R&D activities at some of the nation's most well-known technology companies, including Exxon, Gould, and AT&T Bell Laboratories. For years, a person who wanted to indicate David's stature in the U.S. research community would probably mention first that he was science advisor to President Richard M. Nixon from 1970 to 1972. David is back in the limelight, this time as chair of a high-level National Academy of Sciences panel on ethics in research, at a time when Congress, the public, and the media seem determined to find evidence of malfeasance among institutions and individuals in academe and science.

A native of North Carolina, David earned a bachelor's degree in electrical engineering at Georgia Institute of Technology. In 1945, he joined Jerome Wiesner's group at the Research Laboratory of Electronics as a graduate student doing microwave research. In 1950, at the age of 25, he received a PhD, and he spent the next 20 years establishing his scientific career at AT&T Bell Laboratories. A specialist in computer simulation of signal processing systems like speech and hearing, David ultimately became executive director of research in computing and communications at Bell Labs.

In September 1970, David succeeded his graduate school mentor as White House science advisor. Wiesner, who had served President Kennedy, was a well-known opponent of the Vietnam war, and former presidential assistant Peter M. Flanigan remembers hearing suggestions that the next science advisor should be "more practical." David, Flanigan notes, developed a style of his own: "When it came to politics, he realized there were others in the house who had a view."



Edward E. David, Jr., ScD '50

David proved adept at balancing competing interests and scarce resources. For example, the space program was constantly under pressure to cut its budget. "He fought to retain the last two Apollo missions, but recommended unmanned missions after that, saying that machines could do the job just as well for less money," Flanigan recalls. David not only supported pure science and technology research, but the laser-guided bombs, Tomahawk missiles, and M-1 tanks used in the Persian Gulf are also direct descendants of projects funded on his watch.

However, he is most proud of his work in establishing the Environmental Protection Agency and promoting nuclear power, conservation, and clean energy programs—all ahead of the first oil embargo.

President Nixon abolished the White House Office of Science and Technology after David departed in December 1972 to become executive vice-president of R&D at Gould Inc. (The office was later reestablished by President Ford.) In a letter read at the award dinner, Nixon said that David's advice was "always concise and direct, without the useless rhetoric which often characterizes presidential staff papers."

In 1977, David joined Exxon as president of Exxon Research and Engineering—the first time in its history that company had brought in any officer from outside. Exxon's corporate R&D budget of \$500 million was then among the largest in the nation, and its staff of

4,200 was spread over four laboratories in the United States, one in Canada, and two in Europe. He found the move from electronics to oil easy because "all chemical companies are heavily reliant on electronics for process control, so there's a lot of overlap." Under David, Exxon evolved important catalyst technologies, as well as clean- and synthetic-fuel research.

A life member of the Corporation, David has been a member of the 10-member Executive Committee since 1979. He served on MIT's recent presidential search committee and on visiting committees from EECS to Linguistics and Philosophy. He works for MIT, he says, because "others showed willingness to educate me to survive and contribute in the United States, and I want to give something back. Private universities are under great pressure for a number of reasons but are necessary for continued national excellence."

David has been active in education on the secondary level as well. In the late 1960s, he helped write a curriculum for basic technical literacy. Entitled *The Man-Made World*, this course was adopted by many high schools and liberal arts colleges. The textbook, written by David, John Truxal, '47, and E.J. Piel, won the Lanchester Prize in 1971 from the Operations Research Society of America.—Diana ben Aaron, '85. □

*The author is a freelance writer and a research analyst at The Research Board in New York City.*



# The Masque of Power

## *The Ultimate Housewarming Party*

BY LISA WATTS

**T**he year is 1916. A dozen eggs cost 15 cents. Tuition at MIT costs \$300. There are 1,900 students enrolled at the Institute, 18 of them women and 122 of them foreign. And on this early summer evening, thousands of alumni are gathered in the Great Court (now Killian) to mark both MIT's fiftieth anniversary and its move from Boston to Cambridge.

As dusk sets in, searchlights from the Back Bay campus and from the new Cambridge buildings cross in the sky over the Charles River. A great white barge carrying faculty leaders and Corporation members--along with the Tech Glee Club and orchestra--makes its way across the water from Boston. A flotilla of smaller craft follow, visible each time



ARTIST'S CONCEPTION  
NIGHT-VIEW OF PROPOSED PAGEANT  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY • JUNE 13 1916



1

fireworks light the basin. On the Cambridge shore, the MIT dignitaries disembark and are led to seats in the courtyard.

Then, chaos. A curtain of steam lifts to reveal dancing figures representing earth, air, fire, water, steam, and electricity. From the steam emerges Time Spirit, another dancer, who quiets the chaos. With this first dance begins a 90-minute pageant of the history of humanity, from Primitive Man and his harnessing of fire through the emergence of Will and Wisdom, then Greed and War and Vainglory, then Righteousness. In a procession of the ages, all of civilization parades by, from the earliest Egyptians, Greeks, and Byzantines, through the Crusaders and on into each of the last seven centuries.

The Masque of Power was performed just that once, on June 13, 1916. The scale of the event is difficult to imagine today: 1,700 students and faculty members, all elaborately costumed, held parts. Five hundred choristers from the Boston area sang, accompanied by a 100-member orchestra. And in true Tech style, the lighting and special effects were all cutting-edge.

An excerpt from the July 1916 *Technology Review* offers a snapshot of the performance. "The lights turn to scarlet, the brass blares, and out from the dark behind the Time Spirit's throne dash four great figures on horseback, War, in full panoply, Greed, with the boar's head, Vainglory, with the cockscomb, and Selfishness. Civilization waits, for behind them march two bands of Pyrrhic Dancers, helmeted and shielded, in scarlet and bronze, armed with long spears. The white lights set their arms gleaming like fire. . . . War and his minions spur toward the waiting

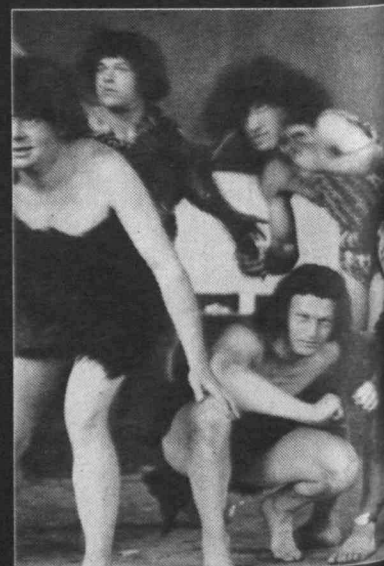
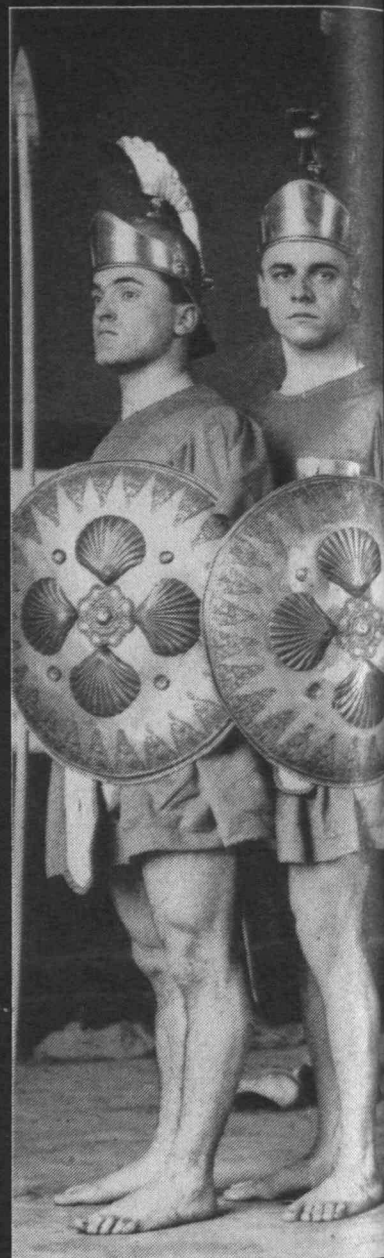
groups of Civilization, urging them on, until in a moment the whole court is filled with swaying striving figures, the forces of humanity disrupted by strife. Fire and his train dash among them with smoking torches; the Elements strive again to resume their thrones. All across the courtyard Humanity is falling to earth in the death-grip. Chaos is come again."

The mastermind behind this extravaganza was Ralph Adams Cram. A professor of architecture who had joined MIT just two years earlier, Cram wrote the pageant and designed the costumes and the *Bucentaur*, the great barge. Fittingly, he also played the roles of Merlin and pageant marshal.

Cram was a dreamer on a grand scale. He admired the lifestyle of medieval times and taught the history of medieval architecture. He even designed Whitehall, his family's "compound" in Sudbury, Mass., in medieval style. Apparently, staging the Masque wasn't enough to satisfy Cram's romantic bent. He lobbied, though unsuccessfully, to host a 1920 world's fair on the Charles River, where he envisioned a network of lagoons and islands creating a "fairy city" and miniature Venice.

For the alumni entertained by Cram's pageant, the Masque of Power capped a whirlwind few days of reunion and anniversary events marking MIT's move into a new era. The festivities ended the night after the pageant with a dinner at which Orville Wright and Alexander Bell were featured guests. In a technical feat for the times, 35 alumni clubs around the country were connected by telephone wire to wish Tech and the assembled guests a happy fiftieth.

Still, the pageant was the most visible, tangible event of the week.





4



3



2



5

Celebration of MIT's move to Cambridge began with (1) the Bucentaur, "Mother Technology enlightening the World" on her prow, carrying dignitaries and (2) an elaborate chest containing the MIT seal and charter across the river to their new home. Even more dramatic was that evening's pageant, recounted at length in the July 1916 *Technology Review*: (3) "Brawny, brown men-things, their matted black hair falling over bestial faces, clad only in beast skins—these are Primitive Men called forth to conquer nature." Will and Wisdom come to their aid, moving them toward Civilization. But wait: enter the Pyrrhic Dancers (4), who march behind War, Greed, Vain-glory, and Selfishness, dark forces that bring Humanity to the edge of extinction. Will and Wisdom reappear, accompanied by Righteousness, whereupon "Civilization lifts its head and adores her." Merlin (5) (aka Professor Ralph Adams Cram) enters leading Alma Mater and the seven Liberal Arts, and thus are launched the Great Ages of Man.

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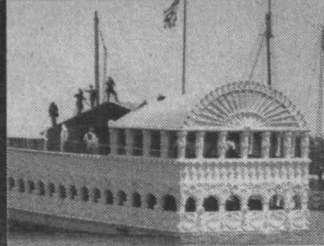
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*The Bucentaur was modeled after its namesake, the state barge of the Venetian Republic, in which the Doges yearly wedded the Adriatic. After the pageant, it was towed to the Union Boat Club and used as a dance floor until it eventually sank. It still sits on the bottom of the Charles.*

Newspaper accounts offered rave critical reviews, noting the innovation of the production. "To the great majority of those who have been accustomed to the plays given under the ordinary limitations of the theater, [the Masque of Power] was a revelation. It was a poetry of the masses in which all the vital things of modern development found symbolic expression," wrote one *Boston Globe* reporter. A *Boston Weekly Transcript* reviewer wrote that the show achieved "symbolism without obscurity, [and it was] pictorial and animated without a loss of dignity."

On campus, the students' review of the pageant was probably a bit less magnanimous. One 1917 alumnus, speaking at a reunion function in 1975, said he had been asked many times what the students' reaction was to the show. "Not much," he said. "They were certainly impressed by the pageant, and thrilled to be part of the fiftieth reunion, but the significance of the event likely was lost on them."

Perhaps not on all the students. On June 17, the day after the masque, a *Tech* editorial tried to put to rest the question of how well-rounded MIT students are. "The conception and production of the Masque of Power should afford food for thought to those shallow-minded individuals who see a lack of the 'cultural qualities' at the Institute, persons who fail to realize that culture is a result of certain processes rather than the spontaneous absorption of a prescribed amount of superficial material."

Some debates never cease. □

*The author is a frequent contributor to Technology Review.*

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## Racking Them Up: From NCAA to Rhodes

Christmas came early last fall for MIT football player Darcy Prather, '91. In the space of a few weeks, Prather won enough athletic and academic honors and awards to make his parents consider adding more space to their Hazlewood, Mo., home.

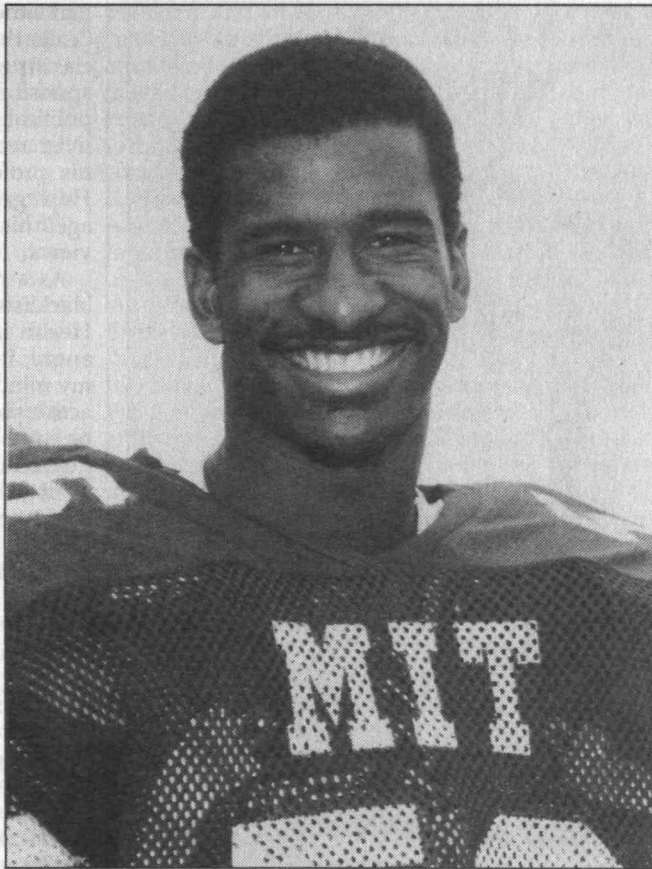
In late November, Prather, an inside linebacker and co-captain for the Beavers, was named the winner of a National Football Foundation and Hall of Fame (NFFHF) Scholar/Athlete Award. The NFFHF award, which is given to only 22 college football players in the country, carries with it a \$10,000 postgraduate scholarship.

But Prather, who carries a nearly perfect grade-point average as a dual major in EECS and Science, Technology & Society, will have to defer the award for at least two years. On Friday, December 7, he was named the winner of a Rhodes Scholarship. As one of 32 recipients from around the country, Prather will spend the next two academic years studying politics, philosophy, and economics at Oxford University.

The following Sunday, the awards continued to roll in for Prather. He received his third consecutive first-team All-Conference Award at the Eastern Collegiate Football Conference Awards Banquet. The head coaches in the conference also honored Prather with a special award for on- and off-field contributions to the conference.

The next day it was announced that Prather was named to the New England Football Writers All-New England team. The team is composed of athletes from all colleges in New England regardless of division. Prather was one of only three Division III players on the 24-person squad.

The College Sports Information Directors of America (CoSIDA) named him a first-team GTE Academic All-American on Tuesday, December 11. At the team banquet that evening he was



*Darcy Prather, '91*

named the MIT team's most valuable player for the second consecutive year and received an MIT wristwatch for earning four varsity letters in the sport.

Wednesday's honor was winning an NCAA postgraduate scholarship for football. Only 29 players in the country are selected for the honor, which is worth \$5,000 in aid for graduate school at any NCAA institution.

Prather could take a break from the limelight on Thursday. On Friday came the announcement that he had been selected as a Division III winner of the Woody Hayes Leadership award. The Hayes Award is only two years old, and is presented to six outstanding scholars/athletes/leaders in community service in the nation, a male and female in each of the NCAA's three divisions. (Last year, MIT wide receiver Anthony Lapes, '90, won for Division III.)

"Darcy is a perfect example of some of the things an MIT student/athlete can accomplish," MIT head football coach

Dwight Smith says. "He's very quiet and unassuming, but the desire to excel simply burns within him." Smith has had the privilege of watching Prather set eight different MIT defensive records during his tenure. His teammates nicknamed him the "Stealth Linebacker" because of his ability to remain undetected by opposing offenses until he makes the tackle. He started in all 32 games while he was on the team.

"Darcy Prather is not the most talented football player we've ever had here," MIT defensive coordinator Dick Yule remarked when making Prather's 1990 MVP presentation. "What he did that set him apart was constantly and consistently work at making himself the very best player he could possibly become."

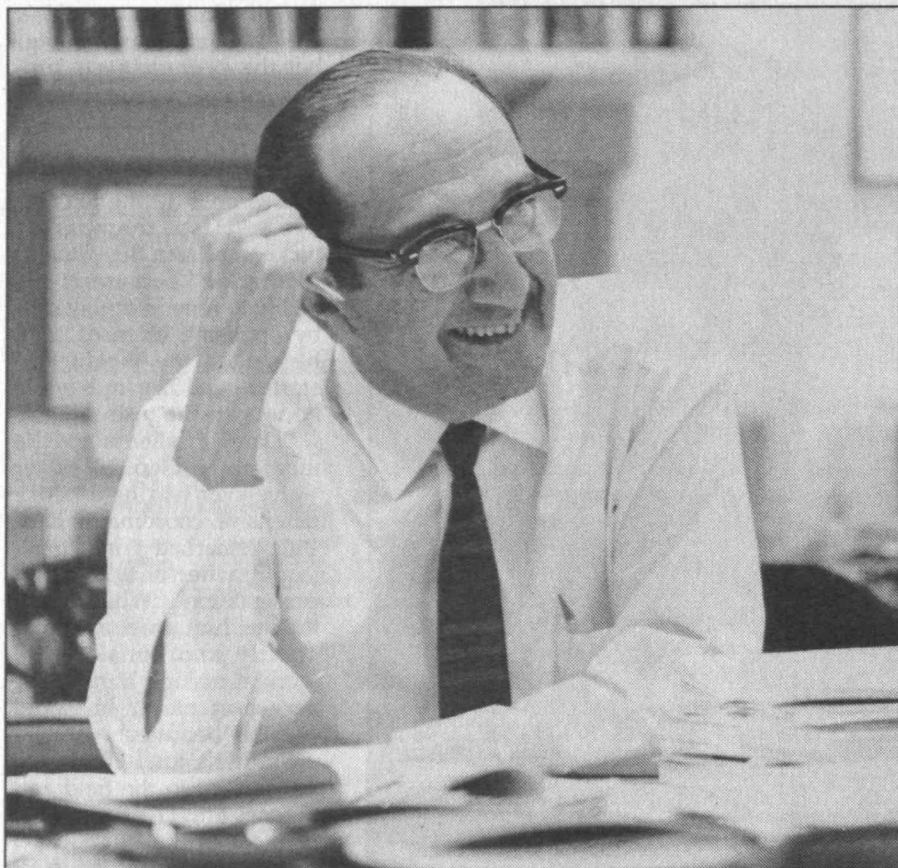
Prather's total effort was not limited to the field and classroom. A four-year member of the MIT Gospel Choir, Prather also made his mark with both the MIT and regional chapters of the Society for Black Engineers—serving as regional secretary in '88-'89, chair of the 1990 regional conference, and president of the MIT Chapter of SBE for '89-'90. His election as captain in football for two years and co-chair of his living group provides further testimony to Prather's popularity among his peers.

Although the fall season wasn't all they'd hoped for, says Coach Smith, "our defense improved every week from the beginning of the season, and Darcy's leadership was the biggest reason. He could cover a lot of errors made by other people, but more important, when the other guys watched him play at that level and that intensity, it inspired them to play better. Even more important than awards or honors he's earned, Darcy is just a great person and a really nice guy. It's pretty obvious that the football field isn't the only place he'll be missed around here." □

ROGER CROSLLEY is director of sports information at MIT.

1912-1991

## Salvador E. Luria *Nobel Laureate in Biology*



**I**nstitute Professor Emeritus Salvador E. Luria, a molecular biologist, died of a heart attack on February 6 at his home in Lexington at age 78. He is remembered by the world for sharing the 1969 Nobel Prize in physiology and medicine for his research into viruses. But his colleagues will remember him as much for his humanism and his intense commitment to peace. Few were surprised to learn at his memorial service that Luria once remarked, "It's good to get the prize in biology, but I wish it was the peace prize."

High on Luria's curriculum vitae was the fact that he founded the MIT Center for Cancer Research in 1972 and served as its director until it was a universally respected program in 1985. But just as revealing of the man is the fact that he taught a course in world literature to graduate students at MIT and to medical students at Harvard to ensure their involvement in matters outside science. Science, Luria believed, was an exploration of the external world; poetry was

the exploration of the inner world. For him, both were essential.

A physician and scientist, Luria was the first to discover the phenomenon of virus host restriction in bacteria; this work led to the discovery of "restriction" enzymes which formed the basis of modern recombinant DNA technology. With Max Delbrück of the California Institute of Technology and Alfred Hershey of the Carnegie Institute in Washington, Luria was awarded the Nobel Prize for their "discoveries concerning the replication mechanism and the genetic structure of viruses." That same year, Luria and Delbrück also received the Louisa Gross Horwitz Prize for their work on genetics of bacteria and bacteriophage, which led to the birth of what became known as the "phage group," the core of what in turn became molecular biology in the United States.

An outspoken member of the peace movement, Luria was openly critical of the American intervention in Vietnam and the Israeli invasion of Lebanon. He

had little patience with scientists who "exile themselves from the arena of social struggles" and thus shirk their responsibilities to society. Impatient with political theorizing, a fellow political activist recalled, Luria was energized by his profound indignation at injustice. He organized, protested, and encouraged his students to form strong world views.

As a result of his candor, Luria was blacklisted by the National Institutes of Health in 1969. Although it made him angry, it didn't silence him. "I made up my mind that as a citizen I would be an active participant in American politics," he once said, "taking advantage of the democratic opportunities that were not available to me in Italy. What scientific achievement I have reached is due to the freedom provided in this wealthy country to all aspects of intellectual enterprise."

A Jew born in northern Italy, Luria earned an MD at the University of Turin in 1935. He fled Italian fascism in 1938 to spend two years at the Institut du Radium in Paris. The German invasion of France forced him to move on again, this time to the United States.

He did research at Columbia, Vanderbilt, and Princeton Universities, and taught at Indiana University and the Universities of Colorado and Illinois before coming to MIT. Among his subjects were biophysics, zoology, bacteriology, and microbiology. At Indiana, one of his graduate students was James D. Watson, who shared the Nobel Prize in 1962 for the discovery of the structure of DNA.

When Luria joined the MIT faculty in 1959, he organized a new teaching and research program in the field of microbiology. In 1970, in recognition of his important contributions to his field, to society, and to MIT, Luria was named Institute Professor.

His aforementioned love of literature was not his only interest in the arts. He was an amateur sculptor and managed to combine sculpting lessons with science while on a fellowship to Paris in 1963.

Wrote James Watson in a tribute to his former teacher in *Nature*: "Luria was an exceptionally talented writer. His scientific papers, textbooks, and books for the general public all reflect mastery of  
*Continued on page MIT 13*

# MIT Students Create a Voice for African Technology

Mawuli Tse, '90, winces at the idea of "appropriate technology" for developing countries in Africa. The concept, he says, boils down to foreign experts scaling back technology because "Africans can't really handle this."

So when he and Karanja Gakio, '88, went around the Institute trying to enlist support for a new magazine on African technology and were told that they were probably duplicating someone else's efforts, and in any event, "students can't handle this," they felt doubly challenged.

Gakio, a Kenyan, and Tse, a Ghanaian, produced the first issue of *African Technology Forum* in August 1988. They learned editing and desktop production by the seats of their pants and paid the initial printing costs out of their own pockets. "Basically it was a disk-based publication," says Tse. "We went around with a diskette and printed it out wherever we could."

Begun as a newsletter of mostly technical reprints, the *Forum* has matured into a magazine that offers reports and opinion pieces on topics ranging from insect control to medical expert systems, solar power applications, and transportation. After the initial publication, a staff of student volunteers produced two issues in 1989 and three in 1990. The *Forum* goes quarterly in 1991.

Circulation, which was steady at 1,000 copies, jumps to 3,000 for this year's spring issue: 1,000 copies go to mail subscribers here and abroad; 1,000 will be shipped to a commercial distributor in Ghana; and 1,000 will actually be printed and circulated in a Kenyan edition.

The magazine's track record has won the students more than just the satisfaction of beating the odds. Before Paul Gray, '54, stepped down as president last year, he awarded them a \$5,000 grant for production and printing, and the organization USA for Africa donated \$5,000 for a computer.

Clarence Williams, assistant to the

president and an equal opportunity officer at the Institute, recommended the students for the president's grant. The magazine's strength, he says, is that it creates much-needed dialogue between technology experts at universities and Africans in the field.

Willard Johnson, professor of political science and member of the *Forum* editorial board, agrees. "The missing pieces of the puzzle of developing Africa are awareness of the problems faced by Africans and knowledge of the level of invention and adaptation needed," says Johnson. "These students are stimulating a process of technological interest and creativity. There's a lot of invention going on at the local levels, and this magazine is spreading the word."

"The publication is certainly filling a void," says Richard Taber, assistant director of the MIT Technology & Policy Program (TPP). "So much of the available literature is either high tech or political science/economics. Technology and technology transfer are given a lot of lip service, but there's not a lot of good writing out there."

Tse says he founded the magazine because of that information gap. It appeared that either there was nothing

being written or nothing being done about technology in Africa. "If there was nothing being done, we had a problem. If there was just nothing being written, then we might be able to change that."

The *Forum* aims at three levels of readers: professionals in the field, who can learn about activity in parts of Africa outside their own; policymakers, who tend to have few objective sources of information, the students say; and a general audience of people concerned about Africa's development.

Readers could see Africa's technology problems in microcosm in a story on Zimbabwe's telecommunications system in a recent issue. The state-run utility faces an exploding consumer base, tight funds, and outdated equipment, with no local manufacturer of spare parts. State laws either forbid new technology such as modems for security reasons, or require a lengthy and unreliable registration process for equipment such as fax and answering machines.

As Gakio points out, the Zimbabwe phone system also provides an example of what he calls indigenous technology. In response to demand for increased ser-

*Continued on page MIT 13*



From left: Anne Khaminwa, Alex Dadson, '91, Karanja Gakio, '88, Mawuli Tse, '90, and Darcy Prather, '91, work on the March/April issue of *African Technology Forum* in Tse's apartment.

1909-1991

## Edwin Land

### *The Father of UROP*

When Edwin H. Land died on March 1 at the age of 81, MIT lost one of its most visionary benefactors. His generosity with his time and ideas, as well as with his financial resources, was all the more extraordinary because he was an alumnus of Harvard, not MIT, and in fact built the Polaroid Corp., a science- and technology-based company, without the benefit of any college degree whatsoever.

Din Land, as he was known to close friends and associates, took an avid interest in undergraduate education and had been a Visiting Institute Professor at MIT since 1956. The following year, in an address entitled "Generation of Greatness," he challenged the Institute to spearhead a sea change in the entrenched academic system under which professors lectured while students merely listened. That speech set in motion what was arguably the most significant development in MIT undergraduate education since Karl Taylor Compton arrived to put engineering education on a firm scientific footing.

Land proposed to fuel scientific curiosity and initiative by encouraging undergraduates to engage in original research. In 1968, he made a gift of nearly \$1.5 million that enabled MIT to put his ideas into action by launching the Undergraduate Research Opportunities Program (UROP) the following year.

"Since [1969] some 20,000 MIT students, the cream of engineering and science undergraduates, have grown, bloomed, and often patented and published as junior colleagues in partnership with faculty on projects of mutual interest," UROP's founder, Margaret MacVicar, '65, commented in *Tech Talk*. MacVicar, who is the dean for undergraduate education, professor of physical sciences, and the Cecil and Ida Green Professor of Education, voiced a widely subscribed sentiment when she added that "MIT, its students, and this nation are deeply indebted to Edwin Land for his insight and inspiration."

Paul Gray, '54, chair of the Corporation, has said that "UROP is, to my mind, the most important program at the university. It brings students right up close to intellectual novelty, to questions that don't yet have answers, ques-



*In a 1948 AP wirephoto, Edwin Land, left, demonstrates his new picture-a-minute photography to Charles Phelps, president of the Photographic Society of America.*

tions that haven't been addressed before."

On sturdy towers of such previously unanswered questions, Land built his own versatile career bridging science, industry, and art. But the question that earned him his commission as a captain of business and industry came from his daughter Jennifer in 1943. With the piercing logic of a three-year-old, she asked why she couldn't instantly see photos her father had taken of her.

An afternoon of thought followed by three years of intensive collaboration at Polaroid led Land to produce the prototype "picture-in-a-minute" camera in 1947. The clunky Polaroid Land Camera and its many streamlined successors found a worldwide audience eager to be captured in and captured by sepia tones, black and white, and finally, vibrant color.

Three-D movies, polarized sunglasses and ski goggles, non-glare automobile headlights, and camera filters are a handful of the more well-known products that Land brought to market. He also turned his talents to guided missiles, sighting devices on military hard-

ware, and optical equipment important in science and medicine. He held 537 patents, a record second only to that of Thomas Edison.

"Edwin Land persuaded millions of Americans and people around the world to innovate with him," said Victor McElheny, director of the Knight Science Journalism Fellowships and a spokesperson for Land's Rowland Institute for Science. "He had oceanic powers of persuasion. He was able to win the participation of everyone, from lab technicians to Wall Street financiers."

Brought to Washington by James Kilian, '26, then president of MIT, Land served as chair of a secret intelligence committee under President Eisenhower. Land urged the development of aerial surveillance systems, including the extraordinarily successful U-2 spy plane. He was a member of the Scientific Advisory Committee to Presidents Kennedy, Johnson, and Nixon.

"Whenever we would go to talk to the president," recalled Jerome Wiesner, science advisor to Kennedy, "we would decide who would make the presentation. It was always Edwin, because

everyone thought he was the most eloquent."

While the gift that led to UROP is perhaps the most notable of Land's benefactions to MIT, it is by no means his only form of support. Many of his gifts were anonymous, but he is known as the donor of the Zacharias Professorship in Physics. He was a member of the visiting committees for the Economics and Physics Departments and for Whitaker College.

In memory of Peter J. Eloranta, '68, the son of a long-time Polaroid associate, Land founded three summer research fellowships that have been offered since 1968 for students engaged in highly original, innovative research, "the kind of work Land had done himself," observed Norma McGavern, director of the Undergraduate Education Office.

Countless MIT students have benefited from Land's commitment to unconventional education. Elizabeth Seifel, '78, helped run experiments on color blindness at Polaroid during the summer and academic semesters of 1975-76. She remembers the intellectual charge of weekly meetings on vision theory with Land and his researchers.

"His thinking was light years ahead of most people," she said. "He looked laterally, instead of vertically. He was always pulling in angles from other disciplines to help come up with new inventions."

For many years, Land's trailblazing ideas on how humans see color "were rejected as crazy, irrelevant, and impossible to investigate," Victor McElheny said. During the last decade, however, his Retinex theory of color vision has received wide recognition.

A largely self-taught physicist, Land entered—and left—Harvard twice while developing his breakthrough invention, an inexpensive, synthetic light polarizer. On the strength of it, he launched Land-Wheelwright Laboratories in 1932.

In 1937, he bought out his partner George Wheelwright III and founded Polaroid Corp. The original high-tech start-up, it began life in a Cambridge garage. Under his leadership, Polaroid grew into a corporation that was not only successful but socially progressive. In 1980, after an unhappy struggle triggered by heavy losses on the Polavision instant movie system and the SX-70 camera, Land resigned as CEO of a com-

pany worth \$1.4 billion.

He didn't retire. Instead, he created the Rowland Institute for Science, a haven for original research free of the usual scramble for grants and the heavy load of academic obligations. And, in collaboration with the Boston Museum of Fine Arts, he also perfected a system to replicate valuable artwork.

A recent comment by his close friend and colleague, President Emeritus Jerome Wiesner, stands as a fine epitaph: "Din Land never accepted the common wisdom about anything. His goal was always to further creativity and individual research." □

FRANCESCA COLTRERA is a freelance writer based in Somerville.

## LURIA

CONTINUED FROM PAGE MIT 10

his adopted English language. His first popular book, *Life: The Unfinished Experiment* (1973), won the National Book Award [and was translated into German, French, Italian, Spanish, and Japanese], with his autobiography *A Slot Machine, A Broken Test Tube* (1984) lucidly describing his intellectual and humanistic development. I remember him to be a teacher of the first rank. In autumn 1947, after only a few days into his course on viruses, I wanted to do my PhD under his supervision. It was typical of his devotion to his students' future success that he later arranged with John Kendrow for me to go to the Cavendish Laboratory where I was to meet Francis Crick."

Luria received honorary doctor of science degrees from many colleges and universities, including the University of Chicago, Indiana University, Brown, and the University of Palermo. From 1984 until his death he served as senior scientist at the Repligen Corp., a biotechnology firm in Cambridge.

At the memorial service in April at MIT, several of Luria's friends and colleagues shared their memories. Professor Emeritus of Biology Boris Magasanik spoke of Luria's respect for thorough professionalism—the ability not only to do the work, but to come to terms with its implications. A favorite Luria maxim quoted by Magasanik: "What is not worth doing at all is not worth doing well." □

vice in the heavily populated rural areas, where phone lines are much more expensive to install and are rationed first to places such as police offices and medical clinics, local technicians designed "party lines" that allow up to 24 households to share a line. Though party lines allow for little privacy, they are cost-effective and highly subscribed.

The writing in *African Technology Forum* sometimes slips into generalities and sweeping introductions: "The arrival of the computer presents a unique opportunity for the developing world." The editing and proofreading also lack some polish: one muddy, contradictory sentence was followed by the stray fragment, "this sentence is not clear to me." The reader would have to agree.

Given that the staff of student engineers are all neophyte editors, however, the quality of the magazine is impressive. With each issue the *Forum* evolves toward the editors' goal of a readable, thoughtful journal. The students' views on such issues as appropriate technology or importing technical experts—strong feelings that clearly drive their commitment to this magazine—come through in staff-written editorials and opinion pieces. But the staff—drawn mostly from the MIT African Student Association—works with contacts throughout Europe and Africa to solicit a range of articles. "We want to hear other voices," says Tse. "We want to encourage discussion of the big-picture questions."

Tse and Gakio stumble over the question of when they will leave the MIT community and what they will do then. Gakio, who completed a master's in aeronautics at Notre Dame and is now job hunting, wants to "amass some applied skills" in his field before returning to Kenya. Tse, a graduate student in TPP and Course II, says he is still figuring out how to make the most impact when he returns to Ghana. *African Technology Forum* might move with them and become an independent publication, says Tse. But for now, "MIT is a good incubator. It shields us from the wild world out there." □

LISA WATTS is a freelance writer and editor.



## CLASS NOTES

### 16

In late March, I stopped in Brockton, Mass., to see **George Crowell** at West Acres Nursing Home. I was informed that he no longer resided there and was now living at his home. I hope that his living at home is an indication that he is well and doesn't require the special care of a nursing home. I will write to George to try to arrange a visit.

In January, I wrote to several classmates with the hope of getting current news for our column. A few of the letters came back with the notation—undeliverable and no forwarding address. I also received word of the passing of two of our classmates: **Coke Flannagan** in June 1989; and **Wilfred Wylde** on January 1, 1991. May they rest in peace. We offer our sincere condolences to their families.

I was interested and very pleased to note the names of our classmates **Alexander Brest** and **James Ralston** as contributors to the Alumni Fund for 1990. Also listed as donors were the widows of **Jap Carr** and **Francis Stern**. Jap Carr and Hildegard Carr and Francis and Gladys Stern were regular attendees at our annual reunions and tremendous supporters of the Class and of MIT. I send my best wishes to Gladys and Hildegard.

Also, I received a nice letter from Herb Lerner, '18. He wrote: "My brother, Hal, was a member of the Class of 1916. He was in both World Wars and in 1938 he directed the salvage operations of the U.S.S. *Panay*. He's gone now for some years but retired as a navy captain. The other day, going over some family papers, I came upon the enclosed copy about him written in 1938 by Admiral Yarnell of the Asiatic Fleet."

It was a letter of commendation for services as officer-in-charge of salvage operations of U.S.S. *Panay* and cited him for "the recovery of large sums of government and private funds, official books and records, and much valuable material from the U.S.S. *Panay*, which was sunk in the Yangtze River about 25 miles above Nanking, China." Thanks Herb, for the interesting insight into one of Hal's many accomplishments.

All best wishes to our sixteeners. Stay well, and please write.—**Bob O'Brien**, acting secretary, 25 Keith Rd., Pocasset, MA 02559

### 17 75th Reunion

When I wrote about the remarkable family reunion for **Penn Brooks** on the occasion of his 95th birthday for the January Class Notes, it never occurred to me that I would so soon have to bring you the news of his sudden death by heart attack on February 22. It does not seem possible that Penn retired 30 years ago as our first dean of the Sloan School of Management.

I scarcely need mention his quarter century with Sears, of which he was VP from 1939 until coming to MIT in 1951. When President Jim Kilian, '26, chose Penn for his new role, he said Penn would be the one to bring to the Institute post of dean "comprehensive industrial experience and a basic understanding of engineering as well as business methods with the capacity to translate that experience into an educational program." So it was at MIT.

Some will remember Penn from student days; from World War II days when he and maybe you together served in the Army, he being awarded the Distinguished Service Cross "for extraordinary heroism in action"; and some may have served on some of the two dozen boards of directors with him.

This is the time to share with you a few words from the widow of a member of the Class of 1932 who habitually browses through various class columns. Her husband had been hired by Penn for Sears. He (her husband) thought the world of Penn and modeled his own behavior towards the people who worked for him on Penn's example. He said Penn Brooks was one of the two finest men he had ever worked for. . . . A lot of us will remember **E. Pennell Brooks** as one of the finest of our friends and associates.

Do write! I don't like to write and you don't like to read only the news of our losses. Let me know by note or phone your latest contacts with other MITers; the joys of a grand or great-grandchild's success; or your reactions to what you hear about your MIT.—**Don Severance**, acting secretary, 39 Hampshire Rd., Wellesley, MA 02181, (617) 237-9378

### 18

Richard F. Lacey, '52, sends the following about his father: "Captain **Henry R. Lacey**, U.S. Navy retired, died March 13, 1991, at his home in Melbourne, Fla. He studied civil engineering at MIT. Upon graduation, he served as an enlisted man in the naval reserve for six months. After his discharge at the end of World War I, he worked for United Fruit Co. in Cuba, and then for Foundation Co. of New York in Peru, surveying for a hydroelectric project in the Andes.

"In 1921, he received a commission in the Civil Engineer Corps of the U.S. Navy. ('Is that when you got married, Dad?' he was asked. 'No, the first year all my money went to pay for uniforms.') In 1922, he married Edith H. Johnson. The marriage lasted 65 years. During the peacetime years of slow promotion, he served tours of duty in Boston, Guam, San Diego, the Canal Zone, Vallejo, Norfolk, Pearl Harbor, and Philadelphia. During World War II, he was public works officer for the Philadelphia Navy Yard, supervising the enormous wartime construction of drydocks, shops, and warehouses. He then served in New York and Guam, and finished his career during the Korean War at the Bureau of Naval Material in Washington, D.C.

"After his retirement to Florida, he devoted himself to raising oranges, and then to golf, which he played until he was 89. At age 80, he put his professional training back to work designing the house in which he lived for the rest of his life. He is survived by two daughters, a son, five grandchildren, three great-grandchildren, and a sister."

On February 21, your secretary was one of ten alumni/ae invited to dinner as guests of President and Mrs. Vest at their home on Memorial Drive. In addition, about 100 MIT seniors were included. We were seated in tables of ten with one alumnus at each. This arrangement gave us an opportunity to hear what the undergraduates are thinking and doing—and for them to get some idea of what is in the minds of graduates. Dr.

Vest and Mrs. Vest were very gracious hosts—we were happy for this occasion to be with them at this informal and happy get-together.

Responding to a story, "The Disease Detectives," in *National Geographic Magazine*, **Herb Lerner** writes: "In 1918, as a student under the noted teacher, William Thompson Sedgwick, head of MIT's Department of Biology and Public Health, I was graduated and was appointed to the U.S. Public Health Service. Assigned to the Florence, Ala., headquarters, my job was to deal with rural sanitation.

"In the midst of the pandemic of influenza that hit the area heavily, Samuel W. Welch, Alabama's Commissioner of Public Health, called urgently for help with an outbreak of smallpox in Cullman County, where there were no health authorities. With a detachment of public health nurses, I was ordered to Cullman to direct control measures. We vaccinated thousands of people, and the epidemic subsided.

"That was 72 years ago, before the creation of World Health Organization, who assures us that smallpox has been obliterated and that vaccination is no longer needed. Hopefully the WHO is right, but it is well to remember that in another generation or so there will be billions of unvaccinated and therefore smallpox-vulnerable people.

... Precisely when the last outbreak of smallpox occurred in the United States I do not know, but it pleases me to remember that three-quarters of a century ago I had a small part in eradicating the disease." Herb recently celebrated his 97th birthday.—**Max Seltzer**, secretary, 865 Central Ave., Needham, MA 02192

### 19

Our class is fortunate to have at this date 29 living classmates. I feel sure that they all enjoy hearing about their former associates and since I do not receive many letters, I telephone classmates and then report to you. I hope you will store up a few notes to give me when I call so I can pass them on in the *Technology Review* class notes.

A few comments on recent calls: I telephoned Captain **Edward E. Saunders**, retired from the U.S. Navy. The Captain answered the telephone himself with a firm voice and we talked briefly about his student days and his later service in the Navy. We both enjoyed the call. I'm certain he'd be glad to hear from any of you who knew him. . . . I called **Leo Kelly** and found him alert and accepting an invitation to be in a parade of the Ancient Order of Hibernians held soon in Corpus Christi, Texas. He was enthusiastic about his acceptance. . . . Later I called **Timothy Shea** and told him of my call to Kelly. Tim was greatly enthused when he realized that Leo was taking part in this famous Ancient Order.

These three members of our class impressed me very much and I hope you will be too, to hear how they are at this late date in their lives.

The continued support of the Institute by the alumni/ae, students, and others is most gratifying. In a troubled world, this wonderful association of people of good will stands tall, and we are all proud to be a part of it.—**W.O. Langille**, secretary, P.O. Box 144, Gladstone, NJ 07934, (201) 234-0690

## 20

Last year, **Charles Klingler** of Milwaukee passed away. His widow, Helen, established the Helen and Charles Klingler Foundation. Their initial bequest has been issued to the Institute. . . . Colonel **Thomas Taber** died last December 9. His home was Brainerd, Minn. He leaves a daughter, three grandchildren, and two great-grandsons. He was a veteran of World Wars I and II. He operated a gun shop and founded Tom's Pet and Hobby shop near his home. . . . **Clinton Bond** of East Dover, Vt., died February 23. While at MIT, he volunteered and served with the U.S. Army Signal Corps and Air Corps. For 30 years, he was an executive of Standard Oil Corp. as manager for East India and was primarily responsible for getting their products "over the hump." Upon his retirement, he served the town as selectman, auditor, town agent, and justice of the peace. He leaves his wife, a son, a daughter, eight grandchildren, and three great-grandchildren. A substantial contribution was made in his memory to MIT. He was truly a worthy representative of the Class of 1920.—**Harold Bugbee**, secretary, Apt. 313, Country Club Heights, 3 Rehabilitation Way, Woburn, MA 01801

## 21

Notice has been received of the death of **Albert S. Genaske** of Fryeburg, Maine, on December 19, 1990. Your secretary remembers the letter received from him within the last few years in which he spoke so lovingly of his wife, Theona, who had just died. Al worked for 40 years as an engineer for the Metropolitan District Commission. **Helen St. Laurent** knew Al and Theona quite well since her summer home in Center Lovell, Maine, is close to Fryeburg.

**Samuel Lunden** recently talked by phone with **Henry Taintor**, who has attended class reunions in the past. He regrets he is unable to attend the 70th Reunion because he is having difficulty getting around now and must use a walker most of the time.—**Sumner Hayward**, secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel E. Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

## 22

### 70th Reunion

It's only a year to our 70th, so get out the Model Ts and plan your drive to Cambridge.

**Art Wasserman**, many years retired from his own company, Marsden and Wasserman, Inc., of Hartford, celebrated his 90th birthday last March. He and Mrs. Wasserman, whom he married in 1983, have since then travelled extensively. The Wassermans still live in Hartford but spend the three winter months in Clearwater, Fla. . . . **Bertha Dodge** in Burlington, Vt., is still writing, but she says, "These are not times for publishing my kind of book." As an indication of what her "kind of book" might be, we could refer to her *Vermont By Choice* published in 1988. This, in turn, suggests that she should continue to write. With my fingers crossed, I include the following written along with the above in March. **Martha Eisman Munzer** was scheduled to go to England in July to the University of Warwick to give a talk at the International Conference of Women Engineers and Scientists. Her subject: "Engineers Are Becoming Ecologically Literate." Martha used MIT as an example of her conclusions.

**Paul S. O'Brien**, Course III, died in Baton Rouge, La., November 9, 1990, two days before his 90th birthday. The 1985 *Alumni Register* indicates his last business to have been president and editor of Alcohol Affairs, Inc. Prior to retirement, he had been for many years with Mobil Chemical Co. in Baton Rouge.—**Yardley Chittick**, secretary, Rte. 1, Box 390, Ossipee, NH 03864

## 23

Writing this in early spring, the report is that we in central Connecticut have just experienced the warmest winter on record. The weatherman predicts 70 degrees tomorrow. The snowfall has been negligible, the biggest storm this winter being 4-5 inches. My crocuses are beautiful.

A letter from our president, **Royal Sterling** makes an early alert—our 70th reunion is approaching. This is a plea for volunteers. Planning must be done early and is under way. Search for a chairman resulted in no candidates, so Royal said he and Mary will take it, his fourth time. Folks, let's not let him down. We need to know who's coming since accommodations will be tight. And as the saying goes, the early bird gets the worm. Tell him what you would like to do in and around Boston. A volunteer is needed concerning the entertainment and someone to handle drinks, who probably would need a car. The new president of the Institute, Charles Vest, is being invited to our banquet. The treasury is low and early expenses (deposits, etc.) must be met. Assistance in the form of checks can be mailed to: Royal Sterling, 2350 Indian Creek Blvd., W., Apt. D-201, Vero Beach, FL 32966, (407) 662-3937.

We have two deaths to report. **James R. Fisher** received an SB in civil engineering and was a member of the Civil Engineer Society while at the Institute. He was a retired surveyor for the United Fruit Co. and spent many years at the company's South American properties. Later, he was employed by Exxon Corp. in Everett and ended his working career with the town of Lexington as a civil engineer. During World War I, he served in the Army and was wounded. He leaves a sister and several nieces. He was a member of the United Methodist Church.

**Scott Fleming Nicoll** died September 6, 1990. He received SB and SM degrees from MIT in mechanical engineering and married Maude Nesbit of York County, Pa. They had two children and six grandchildren. Following graduation, Scott was employed by the York Corp. as a draftsman and senior application engineer. He later moved to Sarco Manufacturing Corp. to become chief draftsman and sales engineer. He was a licensed professional engineer in the state of Pennsylvania. He was a Democrat, a Unitarian, and a member of various civic organizations. His hobbies were folk music, banjo, and guitar picking. Included among other hobbies were boating, resulting in the building of a 16-foot steampaddle tug, *Epplenton Hall*, which sailed from England to San Francisco in 1969. Scott and his wife had a son, now deceased, who was also a graduate of MIT, Class of 1955.

Our sympathy goes out to these two families.—**Frederick O.A. Almquist**, secretary/treasurer, 63 Wells Farm Dr., Wethersfield, CT 06109

## 24

**Dave Evans** sent me a clipping of **Edward S. Taylor's** death. The headline of the obit reads, "Edward S. Taylor, 88, A Pioneer in Aircraft Engine Development." The article goes on to say how he was an international authority on aircraft engines and professor emeritus of flight propulsion at MIT. "He died Saturday (2/2/91) in his home in Lincoln, Mass. His daughter, Marcia T. Fowle of Manhattan, said he died of an apparent heart attack.

"Professor Taylor founded the gas turbine laboratory at MIT and was a director for 22 years. He was a leading figure in the development of reciprocating and gas turbine engines and helped pave the way for the development and refinement of pure jet turbofan and turbine-driven propeller engines used today in high-performance aircraft.

"He worked for the Public Service Corp. and the Wright Aeronautical Corp. in New Jersey before returning to MIT in 1927 as an instructor in

aeronautical engineering. He was also on the staff of the Sloan Automotive Engines.

"Professor Taylor received many awards for his work, including the Sylvanus Albert Reed Medal in 1936 from the Institute of the Aeronautical Sciences for the invention of a vibration absorber for reciprocating aircraft engines. He also received the Robert F. Goddard award in 1973 from the American Institute of Aeronautics and Astronautics for 45 years of contributions to aircraft propulsion. "He was a member of many professional organizations and wrote several books and many articles.

"In addition to his daughter Marcia, he is survived by his wife Julia; another daughter, Mary Adelstein of Waban, Mass.; three stepdaughters, Francesca Moravcsik of Eugene, Ore., Patricia Gahagan of Woodbury, Vt., and Madeline Fletcher of Cambridge, Mass.; a brother, C. Fayette Taylor of Weston, Mass., and 10 grandchildren."

Dave's letter gives insight to the personal side of Edward Taylor. He writes, "He was a shy guy and never came to any of our reunions. But I kept track of him through his brother Philip, who was a great airplane engineer with Wright Aeronautical Corp. The third brother, Fayette, was also a professor at MIT in aviation. Three great fellows—The Taylor Boys. Dave shares with us the fact that "Eddie" was also a really famous silversmith. "He made the U.S. Government gift to the marriage of the present King and Queen of England.

"I could go on for hours about Eddie," writes Dave. Thank you, Dave, for all of this information about an alumnus who contributed so much.

I also must tell you that the class treasurer, **George Lehrer**, has passed away on January 30, 1991, in his home in Weston, Mass. He gave many years of outstanding service as class treasurer. He will be missed.

George founded his own insurance brokerage with offices in Boston and Wellesley. During World War II, he worked for the War Production Board in Washington in the Aluminum and Magnesium Division. After retirement in 1977, George and his wife visited 147 countries. They also had a summer home in West Newfield, Maine. George was a Mason and a member of the Royal Order of Jesters. He leaves a wife of 64 years, Dorothy R. (Ferald), three grandchildren, and four great-grandchildren. Our sympathy goes out to all the family.

A letter from **Richard Shea** has several informative items. The class finances has a deficit of \$1,521.32. He goes on to say, "If we were to conduct a survey of living class members to determine their health, hobbies, etc., it would entail an additional expense of around \$300. In view of these facts, it seems prudent for us to hold off on such an activity, until possibly our 70th reunion in 1994." Richard also reminds us that "it will soon be time to select a reunion chair, select a site, arrange for notifying class members, handle finances, etc. Any suggestions as to someone, preferably in the Boston area, to facilitate contacts with MIT?"

Thank you, Richard, for bringing all this to the class's attention. He also says that any suggestions regarding class activities will be welcome. Hear! Hear!—Co-secretaries: **Katty Hereford**, Box #5297, Carmel, CA 93921; **Col. I. Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480

## 25

A letter from **Fred Greer** in Naples, Florida, brings the unwelcome news that about a year ago he and Eleanor developed severe glaucoma. Although the eye trouble greatly restricts their activities, they still enjoy being together and having reasonably good health. Many years ago, Fred started the Wire Belt Co. of America. Fred's son, MIT '52, is now president of the company, and four of his five grandsons are in the business. The company is doing well, along with their gasket plant.

By the time you read these notes, Fred and Eleanor will have come north to 190 Woodbury St., Apt. 313, Manchester, NH 33102.

There are 136 classmates on the 1925 mailing list, and it would be appreciated if more of you reported on your activities.—**F. Leroy "Doc" Foster**, secretary, 434 Old Corners Rd., P.O. Box 331, North Chatham, MA 02650

## 26

It is March as I write for the July issue. We hope that those of you who came to Technology Day events in June had a good time.

**Albert L. Entwistle** of Louisville, Ky., writes: "I was indeed most sorry to learn of the death of your wife, and you have my sympathy. I lost my wife several years ago and found my whole life changed overnight. I am still plugging along in the restaurant and hotel business, part of which is Howard Johnson's. Hope to attend the reunion next spring." . . . **John B. Jacob** of Columbia, Md., writes to **Bob Dawes**, our class president: "Nearly three years ago we started looking for a new home—one with senior conveniences and medical facilities, and we finally made it into a 'continuing care' establishment. Since we survived this traumatic experience and are beginning to settle down and enjoy our good health, we now plan to attend our 65th reunion in Cambridge this June. . . . **Marvin S. Smith** of Wilmington, Del., writes that he is planning to come to the reunion.

**Russell D. Carlson** of Van Nuys, Calif., passed on May 10, 1988. No further information is available. . . . **John Buss** of Missauga, Ontario, Canada, died in 1990. He was a paper manufacturer, manager of manufacturing, and chief chemist. . . . Mrs. Beatrice Ruff, Widow of **Alonzo Ruff**, died during 1990, while living in York, Pa., and **Roscoe L. Wood**'s widow, of Hawaii, died in 1990. . . . **William "Wally" Farr** of Southern Pines, N.C., writes that his wife, Virginia, died August 18, 1990, and he lives alone. I know his loss, because I lived alone when my first wife died in 1972. Then I married Mary in 1973, and she died in October 1990.

The February 1991 *Reader's Digest* has an article, "The Magic Machine of Ray Kurzweil," MIT '70. For any friend of yours who can't read, this may be the answer. . . . As you know, I am always glad to have letters from our many active classmates. . . . **Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

## 27 65th Reunion

Your secretary had a good visit with **Thomas A. (Tom) Knowles** in Naples, Fla., where he and his wife live in a retirement complex overlooking a fairway. He enjoys good health and we reminisced about our days with the musical clubs when he displayed his talents in his magician specialty act. Tom has a commendation on his wall signed by Orville Wright for his leadership in aviation as president of Goodyear Aircraft Corp. He is presently active promoting the current MIT Fund Drive in the area with many MIT men and women living in western Florida.

Phyllis and I enjoyed a nice visit with Betty and **Tom Russell** at their gorgeous home in Naples. As we sat in their large patio next to their glass-roof-covered swimming pool, we discussed our past mutual experiences. They were remarried in 1976 and purchased their home in 1977. Betty has enjoyed selecting their many beautiful decorations. Tom suffered a severe stroke in late 1989 and he was found to have a constricted heart valve that was too risky to be operated upon. So he must be resigned to a calmer life.

**Walter A. Blake** died on January 1, 1991, in Plympton, Mass. For many years he was an executive of F. Diehl & Sons of Wellesley and served on its board of directors. His former wife,

Marjorie, was one of the Diehl family. He served in the Navy during World War II and had lived in Plympton for the past 30 years.

Phyllis and I have enjoyed south Florida through the winter months. With a regular schedule of tennis, swimming, good food, and a pleasant social life, we've found here the ideal location for healthy living.—**Joseph C. Burley**, secretary, 1 Harbourside Dr., Delray Beach, FL 33483; **Lawrence B. Grew**, assistant secretary, 21 Yowago Dr., Branford, CT 06405

## 28

It is unfortunate that at our advancing years much of our class news has to do with the departure of classmates, and this past winter has taken its toll. We are saddened by the deaths of five since the last *Review*.

**James Stuart Morse**, career employee and executive of the Shell Oil Co., died December 21, 1990, in Hillsborough, Calif. . . . **Charles Hinchman Topping** died January 13, 1991, in Media Pa., after a lifetime of railway engineering in Persia, oil exploration in Venezuela, and research at Du Pont in Wilmington, Del. . . . **Waldemar Innis Bends**, electrical engineer at Lockheed Missiles and Space Co. died January 20, 1991, in Portland, Maine.

**Everett Joseph Delahanty**, an engineer with the Carrier Corp. died January 25, 1991, in Sarasota, Fla. . . . And **Theodore Zavorski**, an engineer with Dravo Co. and American Bridge Co. before a career building many civic buildings in western Massachusetts, died January 29, 1991, in Springfield, Mass. All carried out the competence of their MIT training.

A major change in lifestyle is being enjoyed/experienced by many of our age group. Louise and **Everard (Ev) Lester** have left their retirement home on the James River for a less demanding retirement community, though still in Williamsburg, Va.

As the time draws nearer for our 65th reunion, you will be hearing more regarding its substance. Our class agent, **George Palo**, and our reunion specialist, **Herm Swartz**, and myself as class secretary, with the exemplary support of **Florence Smith**, will be constant reminders until that event. Many, of course, will not be able to attend, but we hope every member will respond to letters and questionnaires with your thoughts and suggestions as this will be the last chance for the true spirit of our class in unison to show its caliber. You have received the agent's letter from George in April and we look forward to helpful response as we will try to plan for the needs and desires of all.

An item of unfinished business is the replacement of our late president, **Walter Smith**. We hope this will be resolved soon for best handling of official commitments.—**Ernest Knight**, secretary, Box 98, Raymond, ME 04071

## 29

I received an interesting letter from **Rolf A. Zurwell** of Forest Hill, Md., as follows: "I am enclosing a copy of my thesis, the work of some 60 years dealing with space energy, the atom, and gravitation. . . . Some may find this work of some interest, others may reject it outright. A few may find new and useful thoughts. . . . Although it seemed as though my work is finished, I am moved to start the quest to harness the space energy which comes to earth in such great quantities. Some basic ideas are coming to fore, but it will be a long research and development project." Your secretary has read the article and in my opinion there are a number of interesting ideas.

**Harold M. Weddle** and wife Esther of San Diego, Calif., have sent the news: "So far, we have six grandchildren and that is all. Two have finished college, three are still in college, and one is in high school. Give us a little time and we'll

catch up with the rest of you. . . . The past year has been a repeat of what we do each year. In the spring we fly to Kansas (our home state) to visit relatives and friends, and Esther's hometown of Manhattan where we both went to college, and then to Lindsborg, my hometown. Our next trip will be to New York to visit our older son Stephen and family. They live in Chappaqua. Our son is vice-president, general counsel and secretary of the Stanley Works, New Britain, Conn. We finish our travels by flying to Helena, Montana, to visit our son Richard and family. Richard is a lawyer with the State of Montana in the land development department. We made a second trip to New York at Christmas where Stephen took us and the family to see the musical *Les Miserables*. It was a great entertainment. Best wishes to you both and all our classmates for 1991."

I have an interesting letter from **Arnold W. Conti** and wife Mary from Atlantic Beach, Fla.: "After reading about the demise of so many classmates and especially about Paul Donahue with whom I was associated for many years in engineering and construction, I decided I had better write this while I am still alive. Mary and I recently moved into a retirement community, only one-quarter mile from where we lived. We still see the same friends, enjoy the same activities, listen to the same old complaints, etc. In other words, our lives have not changed much except that we are now free of cooking, house cleaning, grass cutting, and most of those utterly uninteresting hum-drum items of everyday living. In other words, we are enjoying it. I wish we could say we were free of ailments; if I did, you know it would be a tale right out of Aesop. Let us just say that our problems are kept under control with about a thousand dollars worth of pills. So be it. Mary still paints. She recently submitted three of her works to a competition and managed to win only 1st, 2nd, and 3rd. If she doesn't do better than that in the future, I plan to trade her in for two 40-year-olds. In return, she reminds me that when she told a friend that she got a dog for me her friend said it was a good trade. I still serve on one altruistic board, down from three a couple of years ago; play golf two or three times a week, and massage my legs like **Bill Baumrucker** should do; and manage four investment portfolios. As a by-the-way, I recently won the Super Seniors Tournament at our club with a six under par and thoroughly enjoyed the snide and nasty remarks that accompanied the win. Our two sons are doing well in their professions and raising six children. They love Mary and call her Grammy. I am not so popular, so they call me 'Grumpy.' I guess it could be worse—they could call me collect. I've said enough, Karnig. You had better plan to be the survivor of the Class of '29 because I don't know of anyone who would take your job or could do it as well as you do."

I regret to report the death of the following members of our class of 1929: **Thomas W. McCue** of Newton Highlands, Mass., on January 29, 1991; and **Charles H. Topping**, of Swarthmore, Pa., on January 17, 1991. Topping's engineering profession took him all over the world. In the early 1930s, he helped build South Persia Railway, from near Tehran to the Persian Gulf. In 1934, the railroad went through an area where the University of Pennsylvania was conducting an archeological expedition. He was given the task of surveying the site. In his early career, Charles worked for The Pan Amarian Petroleum Corp. in Venezuela and the United States. In 1942, he worked for DuPont holding a variety of jobs in organic-chemicals and engineering, concluding his tenure as architectural manager. He became manager of Swarthmore College for 38 years, established The Friends of the Swarthmore Library, and was named the first president of the library group.—**Karnig S. Dinjian**, secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364, (603) 926-5363

This issue we have a report from **Vince Thormin**, one of our three clergymen. After graduating from MIT in Course IV, Vince worked as an architect for Aluminium Laboratories, Ltd. in Montreal for about 30 years, then decided to become a minister. He studied for the ministry at the United Theological College of McGill University in Montreal. After ordination, he ministered to a number of churches in Canada and is now minister emeritus of the Scarborough United Church of Calgary. In semi-retirement he still visits shut-ins in nursing homes and lodges, as well as hospital visiting. Vince still paints and sketches; the card he sent me bore one of his sketches. . .

**Bob Crowell** reports that he attends meetings of the MIT Club of Southwest Florida and that the meetings are well attended with a good program each time. He had to give up his job as club treasurer for health reasons. He has had two minor heart attacks and a slight stroke, but says he is still "in good shape!"

Mildred and **Ed Giroux**, who attended the 60th Reunion last June, still shuttle between Maine and Florida and are "still painting and showing with some success." The Giroux's son and his wife have bought 17 acres next to the Giroux's 40 acres in W. Baldwin, Maine and are building a house on it. . . **Bob Jacobs** traveled extensively in China in 1989 and got home just as the "shooting started" in Shanghai. His 1990 trip included Russia and both East and West Berlin. . .

**Paul Kimberlin**, who also attended the 60th, lives in Pearce, Ariz., and I sometimes see him at meetings of the Tucson MIT Club. He is a volunteer patient transportation driver and plays a little bridge.

Again, we have notices concerning the deaths of several more classmates: **Arthur Roberts** on September 16, 1990; **George Kloote** last January 17; **Theodore Waddell** on February 3; and **Louise Hall**. Arthur retired some years ago as chairman of the Department of Manufacturing Engineering Technology at Norwalk State Technical College in Norwalk, Conn., where he had taught for many years. He was the author of two books published by McGraw-Hill, *Numerical Control Programming and Manufacturing Processes*, designed to be used as textbooks at the community college level. At the time of his death, he was living in N. Miami, Fla. My records indicate that he is survived by his wife, Josephine, and four sons, the youngest of whom graduated from MIT in the Class of '73.

**George Kloote** worked for many years for the Haskell Division of Evans Products in Grand Rapids, Mich., and at the time of his retirement was chief engineer of that division. He was living in Holland, Mich., at the time of his death. He is survived by his wife, Margaret, and three sons—George Jr., who is an underground construction contractor; Richard, who is a district judge; and Jerry, who is a hospital worker. He is also survived by six grandchildren and five great-grandchildren.

**Theodore Waddell** did not receive his MIT degree until 1931, but he entered with our class and thus can properly be considered a member of our class. He was a mechanical engineer who worked for the Bernitz Co. of Boston and for more than 20 years for the Bigelow Boiler Co. of New Haven, Conn. He was living in Concord, N.H., at the time of his death. He is survived by his wife, Rosamund, two daughters, (Sandra Martin of Weare, N.H. and Roberta Waddell of New York City), and a grandson.

**Louise Hall**, professor emerita of architecture at Duke University, died in the Methodist Retirement Community. She was 85. She earned a bachelor of arts degree from Wellesley College, a bachelor of science degree in architecture from MIT, a brevet from the University of Paris, and a doctorate from Harvard University. She joined the faculty at Duke in 1931 as an instructor in the fine arts and organized the Department of Fine Arts. She retired in 1975. Hall published numer-

ous articles on early American history and architecture including chapters on architecture in both editions of *North Carolina Guide*. Last year, she contributed a chapter in *Architecture, A Place for Women* published by the Smithsonian Institution Press. She was a member of Phi Beta Kappa, American Institute of Architects, the Society of Architectural Historians, Historical Society of North Carolina, and the Society of Mayflower Descendants. Survivors are a cousin, George Sampson of Epping, N.H., and Sarasota, Fla., and a namesake, Mrs. Louise Derr of Chapel Hill.—**Gordon K. Lister**, secretary, 294-B Heritage Village, Southbury, CT 06488

## 31

**Albert Sims**, now retired and living in Englewood, Fla., indicates that he is interested in a Saturday morning TV program that features organ music, played at different locations around the country, usually from churches. He was fascinated by one from New England churches, particularly St. Johns in Portsmouth, N.H. St. Johns has one of the oldest organs in the country (originally at the Brattle Street Church in Boston) that, when first used, was referred to as an "ungodly chest of whistles." St. Johns obtained the organ shortly after the church was built (1808) on the site of Queens Chapel, which was burned in a conflagration in 1807.

**Albert F. Coleman** and **Allen P. Wilson** write that they hope to be at our 60th. Since this column is written in March for publication in July, I presume those who attended had a chance to see them. Allen has a new address: 512 New Market Rd., Tryon, NC 28782.

**Randy Binner** writes and encloses a fascinating page from the *Exxon Annuitant* that mentions an episode in the life of **Ken Jamieson**. Ken went fly fishing at the ledge area of Cross Point Pool on the Restigouche River in New Brunswick, Canada, about 35 miles upstream from where it enters Baie des Chaleurs. Under the laws of New Brunswick, only small salmon that return to spawn may be caught and kept. Ken had the fisherman's luck to hook a large male fish, which he fought for an hour. It weighed about 72 pounds. Incidentally, the largest Atlantic salmon ever caught was in Norway (79 pounds, two ounces). But Ken had to put it back, though some canoeists coming by took some pictures, so I presume Ken may now have them to prove to the other members of the Restigouche Salmon Club, of which he is a member. This tale also appeared in the *New York Times*.

Randy also advises that he had two mild heart attacks, one around Christmas and one late in January. His doctor said that his heart was in good condition but the pipes to it (arteries) were badly plugged with cholesterol, so he had to have a bypass on January 28. Recovery was slow—it was the end of the third week after the operation before he regained his appetite, which admittedly was a novel experience for him. Randy walks two miles a day but says he has "to beat himself to do it." He was expecting to be with us in June, and we pray that he will be there in good health.

This is another sad month with respect to loss of our classmates, but in all of the obits there is a thread of admiration not only for what the individual had accomplished but also for the kind of person he was—someone interested in the community and the welfare of others. My dad once said, "If, when I leave this world, it can be said that the community where I lived was a little better for my having been there, I will be happy." This ideal is the backbone of all successful charitable and fraternal organizations and can in some measure ameliorate the sadness of our loss with a sense of gratitude for having known that person.

**John H. Arnold** of Salisbury Township, near Allentown, Pa., died January 12, 1990, at home, one day before the 45th anniversary of his marri-

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Richard Dattner FAIA, '60

age to Urania, who survives him, together with one son, John H. Jr. of Bethesda, Md., and three daughters—Mary A. Little of Chatham, N.J.; Susan A. Birk of Farmington, Conn.; Kathryn V. Sheppard of San Antonio, Tex.—and nine grandchildren.

After graduating with a master's in chemistry, he went to work for M.W. Kellogg Co. in research and development of petroleum refining and petrochemical processes and later the development of synthetic ammonia and methanol processes. During the war, he was involved in the Manhattan Project and afterwards with Hygro Carbon Research, New York. He was VP of Air Products and Chemicals Co., Tuxedo, N.Y., and after retirement from it in 1962 became involved as consultant to the Nuclear Regulatory Commission.

A note from Sally E. Alkazin, daughter-in-law of Joseph J. Alkazin advises that he died December 18, 1990, in California and is survived by his wife, Antoinette. She reports that Joseph was always proud of being an MIT graduate and that he would have been pleased to be a part of our celebration in June (and we would have been happy to have him and Antoinette).

Joseph was cost engineer for John Petrossi Co. in Rochester, N.Y., and later was employed by American Airlines at Newark Airport. In 1967, he was the owner of La Jolla Office Equipment and Supply in La Jolla, Calif.

Philip W. Bourne, a retired Boston architect, died of Alzheimer's disease on December 20, 1990, at Sherrill House, a nursing home in Jamaica Plain. Like me, he was originally in Class of 1930, but he lasted longer with '30 than my five weeks. He was quite active, being a member of Delta Psi, on the squash team for four years (winding up as captain), on the junior varsity crew two years, freshman crew, Field Day crew, and a member of the Architectural Society. He afterwards graduated from the Harvard School of City Planning.

He worked as a housing planner for the Public Works Administration and the U.S. Housing Authority, as an advisor to the Hawaii Housing Authority, and as a consultant to the Republic of Haiti and the U.S. State Department before opening his own practice in Boston in 1953. He served as chair of the Massachusetts Art Commission from 1965-77, member of the Massachusetts Designer Review Board from 1965-66, and as president of the Boston Society of Architects, 1964-66.

Some of his more recent projects were the Peabody Museum in Peabody, the Salem Savings Bank, the Concord Public Library, and the G.M. Jones Memorial Library in Salem. He is survived by his wife, Mary Elliot (Nicholson), two children—Sallie Harrison of Topsfield and Jonathan F. Bourne of Holderness—seven grandchildren, and three great-grandchildren.

Standish L. Deake died December 20, 1990, at Mount Ascutney Hospital, Woodstock, Vt. He had a rather varied career. From 1931-38, he was employed by the Commonwealth of Massachusetts in its Conservation Department, concerned with surveys with stream and forest management including pollution problems for which he organized a laboratory for analytical solutions to problems. But, according to his note at our 25th, the political atmosphere got to be too much for him and he switched to teaching secondary school, of which he said, "I did not realize how much I would enjoy it until I tried it." He began his teaching at Milton Academy and later was head of the Science Department at Park School in Indianapolis.

In 1943 he, like many of us, was in the service, serving as a Navy lieutenant in the European Theater. From 1946-51 he was head of the Woodstock Country School, then returned to Milton Academy where he remained until he retired in 1974. In 1980, he returned to Woodstock as a winter resident. He is survived by his "ideal" wife, Genevieve, of Woodstock, and a cousin, Thomas Payson of Yarmouth, Maine.

Francis Dickin Weeks, a retired electrical engineer, died on November 6, 1990, at the Highland Park Hospital of cancer. He received an SB in electrical engineering and first worked for the Commonwealth Edison Co. and later for the General Cable Corp. and the Joslyn Manufacturing Co. He served in the U.S. Navy Bureau of Ordnance during World War II, in production work of anti-aircraft fire control equipment and overseeing fire control on sea trials for many ships. He retired with the rank of commander.

A 54-year active citizen of Highland Park, Ill., Weeks was president of the Elm Place School PTA, during which period he was instrumental in building a safe underpass under Sheridan Rd., connecting to the Morgan Playground. He later served on the Highland Park High School Board, acting as chairman of the Building Committee for the renovation of the high school and the new building for the Deerfield High School. He was a board member of the Highland Park Hospital for many years.

In a long and active retirement, Weeks, an excellent photographer, founded the "Winnisimmet Collection," a compilation of historic, architectural, and artistic slides from the many countries he and his wife visited. He presented travel lectures to schools, clubs, and many organizations, being exceptionally active in the Adventurers Club of Chicago. Weeks' slides have been requested by and are now in the permanent collections of the Art Institute of Chicago, the National Gallery of Art, the Smithsonian Institution, and the Metropolitan Museum, as well as those of many colleges and universities.

Weeks was a loyal alumnus of the Dartmouth and MIT Alumni/ae Associations. He was a member and club archivist for the University Club of Chicago and was active in civic and professional organizations.

He is survived by his wife of 57 years, Elsie Watkins; a son, Charles; two daughters, Diane Cavers and Nancy Waxter; seven grandchildren; and three great-grandchildren.—Wyman Boynton, secretary, 668 Middle St., Portsmouth, NH 03801

## 32 60th Reunion

Rolf Eliassen spent his years at MIT in civil and sanitary engineering and received his doctor of science in 1935. Some might think this a rather mundane field. It is interesting to see how Rolf got to the cutting edge of this field and contributed to the field of environmental waste, radioactive waste, water resources, as well as control of land, air, and sea environment.

After 12 years as professor of sanitary engineering at MIT, Rolf went to Stanford University for 12 years. Meanwhile he was a partner of Metcalf & Eddy, heading up the West Coast operations. In 1973, he became chairman of the board and remained there until he retired in 1988. He did a considerable amount of consulting for government agencies under Kennedy, Johnson, and Nixon.

Rolf writes, "Since the days of our original research on radioactive waste at MIT, I had been associated with the U.S. Atomic Energy Commission. The MIT work also led to my appointment as consultant to the International Atomic Energy Agency (IAEA) in Vienna, Austria, on their problems of radioactive waste all over the world. That led to many trips to Vienna—a gorgeous city—and around the world. So my MIT work really paid off!

"One incident will be of interest to MIT Alumni/ae. While in Burma for the IAEA I said I was a professor at Stanford. The introducing engineer—a former student of mine at MIT—said, 'Nobody here knows Stanford, just say you are a former professor at MIT. That's what counts.'"

Upon Rolf's retirement, Metcalf & Eddy adopted a resolution honoring him for 27 years of service to the company, his contributions to the protection of the environment and environmental engineering, his service to the country as an

officer in World War II and as technical advisor to the White House, and his 100 articles and books on pollution control and waste management.

Currently, Rolf and his wife are in an excellent retirement home in Palo Alto, Calif., where there are lots of Stanford professors and people from professional life.

The family of Col. **J. Paul Breden** has informed us that he died at the age of 86. He graduated West Point in 1928. He was sent to MIT and by 1932 had earned a bachelor's in mechanical engineering. He had many different assignments but he gravitated towards strategic planning. After Korea he was awarded the Legion of Merit citing particularly his work in returning 25,000 prisoners from the Communists. He is survived by a son, a daughter, five granddaughters, and four great-grandchildren.

We have received word that **William A. Hall** died in February. He had worked for 45 years for Atlantic Richfield Refining Co. before retiring in 1972. He leaves his wife, three sons, a daughter, 10 grandchildren and a great-grandson.

Again I urge all classmates to send in material and pictures. There are fewer of us now so we must do more.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

## 33

We received a nice letter from **Henry Rahmel**, 22 Hibiscus Rd., Belleair, FL 34616. He would like to hear from any of us nearby for lunch or whatever. After graduation, he did design work for Automatic Electric, then was an MIT Lab instructor. He later was on the Republican National Committee for Alf Landon, with whom he traveled on the campaign tour. Thereafter, he designed recording studios for advertising agencies, with Northwestern University during the war, then about 30 years with A.C. Nielsen, retiring in 1974.

**Cooper Cotton** sends a card addressing all the old Course XVIIers: "At the place called MIT in the Class of '33 are zanies, dingbats, dopes, and wombats. Don't know what they do for fun, but as of March '91, I have not heard from a single one (except for those departed). Are we illegitimate, illiterate, ill at ease, full of fleas?"

We received a note from Colonel C.T. "Newt" **Newton** of Nokomis, Fla., (813) 485-0549. He retired in 1963, USA Corps of Engineers, and again in 1975 as consulting engineer. He has been married 58 years to Fran, who plays tennis three times a week and gives many volunteer hours. Their last trip was to Indonesia this year.

**Obits.** **John D. Rumsey** died February 2, 1991. He began with Chevrolet during World War II, developing aircraft engines with Jervis Webb Co. and after was chief engineer and contract sales manager. Later, he did consulting with American Chain & Cable, Midwest Conveyor, and Anchor Conveyor. Mrs. Rumsey lives at 4405 Oak Grove, Bloomfield Hills, MI 48013.—**William B. Klee**, secretary, P.O. Box 7725, Hilton Head Island, SC 29938

## 34

Once again my news is mostly bad. I suppose that's rather inevitable at our age.

In January 1990, Col **Daniel F. Shepherd** died in Huntsville, Ala. Unfortunately, I can offer no further information about the late colonel.

Better known to many of us, I think, was **Richard Bell** who died in Scottsdale, Ariz., in December 1990. Dick was prominent around the Institute in our undergraduate years. He was active on the track squad (an Olympic medal winner), was elected class president our senior year, and, as I recall, continued in that post for at least the first five years after graduation. Dick distinguished himself during World War II as a pilot. He flew B17s over the "hump" in Southeast Asia, was shot down twice and released in a prisoner

exchange, commanded a bomber squadron, and at war's end was a brigadier general. His business life was devoted to developments in the minerals field, especially clays and kaolin. He founded several companies in the field, the last being Bell Research Inc., a consulting firm. After he retired from full-time work he was very active in both the International Executive Service Corps and the Service Corps of Retired Executives.

Richard is survived by his widow Anne, three daughters, and four grandchildren. Because of his earlier running activities, one of his daughters, Janice B. Hould, 8014 Warner Rd., Brentwood, TN 37027, has set up a memorial fund in his name to help support the 1992 Olympic games. Any friends who would like to help may send contributions to: U.S. Olympic Committee, Team Support '92, Colorado Springs, CO 80977-1992, attn: Debby Smith.

Also late in 1990 we lost **George E. Best** on October 4 in Baltimore, Md. After graduation he worked for chemical companies in Pennsylvania, New Jersey, New York, and Michigan; and then worked for Mutual Chemical Co., a chromium processing plant in Baltimore. He served there from 1948 to 1959 as manager of technical services, after which he moved to the Manufacturing Chemists Association in Washington. He retired from there as senior vice-president in 1978. Mr. Best was active in several professional organizations; among them as an emeritus of the American Chemical Association, a former president of the National Association of Corrosion, and president of the Baltimore chapter of the American Electroplaters Assoc. His wife Grace had died in 1986 and he is survived by a son Randolph.

October was a bad month for our class; on the 15th **Gilbert Lorenz** died in Highland Beach, Fla. He and Thelma have been faithful attendees at virtually all our reunions. Gil had spent his career in the field of mapping, almost all of it with the Corps of Engineers at Ft. Belvoir, Va. In this work he rose to become the technical director of the Army Engineers Topographic Laboratories. One of the notes I received after his passing was from **Phil Kron** who was a close classmate in school, stayed in touch afterwards, and would see the Lorenzes in winter visits to Florida after retirement. It contained a very touching tribute to Gil, along with information about the serious health problems from which he has suffered for five or six years. In addition to his wife Thelma, Gil is survived by a son, daughter, and five grandchildren.

On October 17, **Edgar Svikis** passed away in Cape Coral, Fla. Unfortunately, I cannot offer any further information about him except that he is survived by his wife Lonia.

On October 27, **Martin F. Cosgrove** died in Waltham, Mass. He had served with the Metropolitan District Commission from 1936 until his retirement in 1977. He was a professional engineer, a registered land surveyor, and was appointed chief engineer of the MDC in 1972; this was the first time in the Commission's history that all engineering functions were placed under the supervision of the chief engineer. In the MDC area this includes "new and used" water, parks, recreation, and flood control. Mr. Cosgrove was a visiting lecturer at Harvard University Graduate School of Engineering where he taught deep rock tunnel design and construction, and a visiting lecturer in aquatic ecology at Worcester Polytechnic Institute, and a member of the Clark University water reuse study panel. In 1977, presumably at the time of his retirement, the MDC named major portions of the engineering works supplying water to Metropolitan Boston after him as a memorial.

From **John Hrones** of Sarasota, Fla., dated March 21: "Today I received a call from Sally Johnson informing me that her father **Fred Johnson** had passed away. I had talked with Fred several months ago at which time he was undergoing treatment for cancer. As usual he was in good spirits and optimistic. Fred and I grew up in Roslindale (Boston). We went to kindergarten

together and were classmates throughout grade school, high school, and MIT. We played hockey in high school and were on the freshman and varsity hockey teams at MIT. Fred was with Fairbanks Morse Co. for many years. Upon retirement he ran a small outfit which designed and built specialized machines. He was a captain in the Army Reserves and served in the South Pacific during World War II. He was a resident of Greenwich, Conn., for many years. His death is a great loss to me and to all who knew him."

It is sad to have to report so many losses and to all the surviving family members I would offer condolences on behalf of all the class.

Now, happily, from the land of the living I have an Alumni Fund note from **Ernie Massa** who writes, "During the past summer, while on vacation in Cohasset, Mass., our two sons gave Jeanette and me a wonderful surprise party for our 50th anniversary—everyone came!"

In response to a limited mailing **Carl Wilson** had sent out (see below), **Mel Sousa** answered, "We wish we could go. Why not hold one on the West Coast? It has been a stressful year and a half since the 55th reunion on Cape Cod, beginning and continuing with Winnie's mother (now 96) who cannot take care of herself and with Winnie's eye—she has had three operations for a detached retina and ensuing complications. Fortunately the eye has survived (20-25 vision). Thank God! The horses and orange grove are doing fine. The grove may be in distress next year because of the drought. My four-year old filly won the highest honors possible this year and the stallion may go to Holland for breeding and showing."

The June notes had some brief information from Carl about the 57th mini-reunion that is being planned for September 24 to 27 at the Chateau Montebello in Ontario, Canada. A letter was sent to those who had shown previous interest in these intervening get-togethers. The Chateau Montebello is midway between Montreal and Ottawa and formerly was the Seigneury Club, one of the foremost resorts in Eastern Canada. So far we know of some 15 couples who expect to go, and to make life easier, we are planning a charter bus to run from Boston and return. The Canadian Parliament will be in session and **Cash Belden**, who lives in Brockville, Ont., is planning a visit and luncheon as part of a day's trip to Ottawa. Our charter bus will be used for this latter trip also.

The cost at the Chateau is roughly \$228 per day per couple MAP, including gratuities, and the estimated cost per couple for the bus is \$250. The committee will arrange parking in Boston for those using the bus and overnight accommodations for anyone driving (or flying) to Boston to pick up the bus.

If you did not receive one of the earlier mailings and are interested in joining this 57th reunion, write **Carl Wilson**, 48 Druid Hill Rd., Newton, MA 02161; or **Laurence Stein**, 374 East St., Hingham, MA 02043. It should be a very pleasant time—a top-quality resort and at the end of September we should find the foliage at peak.—**Robert M. Franklin**, secretary, P.O. Box 1147, Brewster, MA 02631; **George G. Bull**, assistant secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

## 35

**Stocky Stockmayer** sent me a note. In reference to our 50th, "You gave me too much credit for the '90 rowing pictures. **Jim Eng** took those pictures; all I did was get copies made and distributed to various self-styled oarsmen. Not much class news of late. Janet and **Paul Herkart** stopped by sometime in the fall and are in pretty good health. In May I will be making a trip to La Jolla to take part in a 70th birthday symposium for **Bruno Zimm** on May 18." We will try to get together while Stocky is here. He and Sylvia may be going to Sweden in June.

show no way to play and 2,266 show only one way to play. Of the remaining 1,774, 1,222 can be optimally played by selecting the roll of the dice from the markers remaining using as few markers as possible. (Take "8" if you can, not "5 + 3" or "4 + 3 + 1," for example.)

That leaves 552 real problems. These are characterized by multiple ways to play using the smallest number of markers. And it matters—if you have (1,2,4,5,8,9) as the set of markers and roll 10, the choice between 9+1 and 8+2 makes a difference of 4.55 in the expected value! In fact, 239 of the 552 make a difference  $> 1.0$  in the expected value.

I found no good way to determine the right way to play the "club of 552" except to have a list... then I wondered how just *picking at random* from those ways with the least markers would do in practice. Monte Carlo simulation with this simple rule resulted in an expected value of 33.13—good enough for casual barroom play, and easy to remember.

**F/M 2.** Robert High has apparently studied the art of dueling from a mathematical viewpoint. In this he clearly outclasses me since the only mathematical statement I can make about dueling is that it robbed us of much of Galois's expected lifetime.

Two duelists take turns firing at each other. They continue until one of them is hit. As is only fair, the weaker (less accurate) duelist goes first. If his accuracy is  $1/3$ , how accurate must his opponent be for the match to be fair?

Now consider three duelists who take turns firing. Assume each knows the accuracy of his opponents. Is it always optimal to fire at the strongest opponent? Can the weakest duelist ever have an advantage, even if he fires last?

Finally, consider four or more duelists, again with perfect knowledge. Is it always optimal to fire at your strongest opponent? Is it necessary to know one's own accuracy? Can it ever *improve* one's chances to become *less* accurate, even if the overall ordering of the duelists' accuracies remains the same?

For two duelists, Kelley Woods shows that if the first duelist has accuracy  $a$ , the second needs accuracy  $a/(1-a)$  for a fair match. For three duelists, Woods notes that it pays to aim at the stronger (if you hit, it is better to face the weaker than the stronger and if you miss it doesn't matter who you tried to hit). An interesting remark from Matthew Fountain is that you might well be better off deliberately missing. Indeed, the proposer's program, when allowed to "pass," suggests the globally optimal strategy of everyone continually passing and hence everyone having a 1.0 survival probability. An interesting anti-war argument. If passing is outlawed, it is possible for the least accurate shooter to have the highest survival probability. Woods illustrates this phenomenon with the first, second, and third participants (in order of shooting, not accuracy) having accuracy .4, .5, and .3 respectively.

The situation with four or more duelists is com-

plicated. Readers interested in this problem are invited to write to Faith Hruby at *Technology Review* for the proposer's comments (including computer programs), which are too lengthy to be reproduced here.

**F/M 3.** The following problem is from Gordon Rice. Lay out the A, 2, 3, 4, and 6 of spades in that order. Now roll one of the dice from your backgammon set. For each roll of the die, exchange positions between the ace and the indicated card. (If a 1 is rolled, do nothing.) By repeated rolls, we can generate "random" permutations of the six cards.

For a "trial" of  $N$  rolls, a certain set of permutations are possible outcomes. How big does  $N$  need to be for every permutation to be a possible outcome? Are there any  $N$  such that all possible outcomes have equal probability?

The following is an abbreviated version of Matthew Fountain's solution (write to Faith Hruby at *TR* for the full text):

All permutations are possible at  $N = 7$  when  $N$  is the number of rolls, including those in which the 1 turns up. For all permutations to be equally probable  $N$  must be so large that the parity of  $N$  is independent of the parity of  $M$ , the count of those rolls which switch cards. Half the permutations are possible when  $M$  equals six or any larger even number, and the remaining half are possible when  $M$  equals seven or any larger odd number. But as  $N$  increases, the probability that  $M$  is odd approaches  $1/2$  and at large  $N$  the permutations of both halves are equally probable. The probability that  $N - M$  is odd is the sum of the even terms in the expansion of  $(5/6 + 1/6)^N$ . The probability is 0.5057 that  $M$  is odd when  $N = 11$ .

To find out how fast the permutations become equally probable requires much doing. The most probable always remains the starting permutation, and the least probable remains those that had the last chance to appear. The starting permutation has the probability of 2.068/720 at  $M = 22$ , while the least probable have the probability of 1.979/720 at  $M = 19$ .

Robert High notes that for any  $N$  the probability of any given outcome will be a sum of powers of  $1/6$ . Since  $1/720$  cannot be expressed as such a sum, there can be no  $N$  for which all permutations are equal (although this could be the limiting value as  $N$  increases).

#### OTHER RESPONDERS

Responses have also been received from W. Hartford, K. Rosato, and J. Rulnick.

#### PROPOSER'S SOLUTION TO SPEED PROBLEM

Play the club ace and lead the 8. If West plays the king, you have 12 tricks (three spades, one heart, five diamonds, and three clubs). If West plays the 9, you win with the jack and now give East the king of hearts making two clubs and two hearts.

Committee and was presented with the Bronze Beaver. He was on MIT's National Nominating Committee and president of the MIT Cape Cod Club. During World War II, he was chief signal officer, AMET, Command and General Staff School, and was awarded the Legion of Honor. He spent all his business life with the New York Telephone Co. and retired as assistant vice-president. He is survived by two daughters, Deborah N. Aylsworth of Wellesley, Mass., and Elizabeth N. Duenas of Holmdel, N.J., and three granddaughters.

I had a phone call from Les Brooks telling me that Michael Kelakos died February 27. He had heard from Mike's wife Theresa. I also received a note from her enclosing a copy of his obituary. Mike died of complications from Parkinson's disease. In previous Class Notes I wrote of Mike and Les Brooks working together for a number of years. Mike joined the State Department in 1951 and as a member of the Foreign Service served in Greece and Germany. He subsequently was assigned to UNESCO in Paris as deputy U.S. representative, then became scientific attache in Rome, moved to Tel Aviv in 1966, and served there until he retired in 1973. He is survived by his wife; a son, George, of Wollaston; a daughter, Eleni, of Los Angeles; a brother, Thomas, of Lowell; and three sisters, Ann, Ourania, and Dorothy, all of Lowell.

Alfred Johnson died at his home in Naples, Fla., on February 4 after a sudden and brief bout with cancer. He graduated from Boston College Law School in 1944, joining Arthur D. Little, Inc., in 1942. He became the director of Invention Management and oversaw the negotiations and legal proceedings on behalf of an ADL client John C. Sheehan, an MIT chemistry professor whose patented process for synthesizing penicillin has produced \$2 million in royalties from pharmaceutical houses since 1964. Al enjoyed golf and played in our class tournaments from 1960 to 1985. He retired from ADL in 1977 and became a consultant for a Boston law firm. He is survived by his wife Ruth (Hanson); two daughters, Priscilla of Nottingham, N.H., and Deborah McCanne of Aurora, Colo.; a brother, Horace L. of West Yarmouth; and three grandchildren.

Dexter J. Clough, II, M.D., died December 18, 1990, at a Bangor, Maine, hospital. He graduated from the University of Pennsylvania School of Medicine in 1939. After three years of internship, he returned to Bangor and practiced medicine with his father in 1942. Following World War II he limited his practice to ophthalmology and in 1948 was certified by the American Board of Ophthalmology. He was a member and past president of Maine Medical Association, member of the American Medical Association, and life member of the American Academy of Ophthalmology. He enjoyed golf and played in the class tournaments for 25 years. In 1984 he received the George B. Morgan award from MIT for serving with merit for 30 years on the MIT Educational Council. His survivors include a daughter, Frances C. Butler of Mount Desert; two sons, Peter J. of Aurora, Colo., and David R. of South Freeport; one brother, Dr. Herbert T., Jr., of Orrington; three sisters; and four grandchildren. Dexter was predeceased by his wife, E. Frances Palmer Clough, on February 8, 1990.

Patrick J. Mahoney died February 5, 1991, in Natick, Mass., after a long illness. Prior to his retirement in 1985, he had been employed as a chemist for the U.S. Army Laboratories for 25 years. He is survived by his wife, Vivian (Jones); one son, John M. of Salt Lake City; two daughters, Patricia A. Garcher of Valparaiso, Ind., and Lisa M. of San Francisco; and two sisters, Elizabeth Williams and Mary Mahoney, both of Norwich, Conn. . . . I have sent our condolences to the surviving widows, to Dexter Clough's daughter, and to Bernie Nelson's two daughters.

I am sure you are all aware of California's fifth year of drought. For San Diego County it has been very serious since all of our water comes from outside the county. However, the jet stream

I did not hear from Arthur Haskins with his usual Christmas letter bringing us up to date with his and his son's sailing exploits, so I telephoned him a few days ago to learn how he was. His wife Dorothy died January 12 after a long illness and I passed along the deepest sympathy of his classmates to him. He has been keeping busy with work at his church and doing things with his son Dan. Art says he has stopped cutting down trees and is no longer doing any consulting

at Bath Iron Works, where he worked most of his life. I am sure he would enjoy hearing from his friends: call him at (207) 443-2780.

Our class president emeritus and friend Bernard H. Nelson died suddenly of heart failure on March 22 while visiting in Bonita Springs, Fla. Bernie, a member of Beta Theta Pi, served as our class president from our 35th to our 55th Reunions, and he was deeply involved in our class activities as well as MIT. He was on MIT's Awards

suddenly changed its route early in March and we have had one storm after another for the past two weeks, bringing our total for the year, which began July 1, to 10.96 inches compared to our annual normal average of 7.62 inches. In the last two weeks 7.7 inches arrived, with the last foreseeable storm due tomorrow. We are still going to have to live on 50 percent rations, although an additional 10 feet of snow in the Northern Sierras may help us a little. Golf courses can only water greens and tees, which will make us appear like Nicklaus off the tee. . . . Now, How About Those Letters?—**Allan Q. Mowatt**, secretary, 715 N. Broadway, #257, Escondido, CA 92025

## 36

Writing these Notes in March for the July issue, with the reunion ahead, but behind when you read them—what's a correspondent to do? And it will be October before a reunion report is printed, unless I try EXTRA ESP on those who would attend. Well, let's get back to the here and now. . . . **Alice Kimball's** many years of outstanding service to the class and the Institute have been honored again, with a place in the procession at the inauguration of President Charles Vest. The assemblage includes savants from a multitude of colleges, domestic and foreign.

News from assistant secretary **Pat Patterson** includes a card mailed to him from New Zealand by **Phil Gilinson**. Phil and Hulda were on a round-the-world cruise aboard the Queen Elizabeth II leaving from New York City on January 5, returning April 9 in time for our 55th reunion. The route went around Africa instead of via the Suez Canal, keeping away from the turbulent Mideast. Pat's forwarding letter includes: "We are keeping well but I find I am slowing down: slower to start a job and longer to finish it." But apparently he *does* finish—that is more than I can claim for some things to be done in our new-old home.

**Henry Lippitt** forwarded year-end greetings and messages from **Bob Gillette** and Janet, and from **Clax Monro** and Vicki. From Bob: "Apparently your (Henry's) triple by-pass worked well, as did mine—gave us a few extra years. Since I skied at 9,000 feet in Sun Valley last March (and again in '91) I believe it's had a good test." Bob's son Ned married an Olympic skier at Sun Valley last August: "To add to the excitement, relatives young and old had a raft trip on Salmon River the day before the wedding." . . . Clax and Vicki had their annual family reunion in Galveston, a vacation trip to New Mexico and southern Colorado in September, and a drive to Phoenix for a family visit in December. Next time, Clax, try to include Santa Fe on your route so Phoebe and I can see you again!

A letter from **Henry McGrath**: "On January 23, I attended a dinner-dance in Union, N.J., honoring past-presidents of the MIT Club of Northern New Jersey. **Rudy Ozol** (Course X) and I were two of about 15 past-presidents there. You may remember his being captain of the golf and fencing teams. I learned a bit of golf and fencing from **Edward Everett** (deceased 1950) and **Carl Sontheimer** (Course VIII '36 but now listed in '37). Rudy's golf game is still superlative. At the dinner he talked on the history of the Club, which will be 55 years old this year. Karl Taylor Compton was one of the founders."

Our report in the January Notes of **Frank Schoettler's** death mentioned his very successful career in construction, for which he had prepared in Course XVII (later combined with Course I). Now, from **Tony Hittl** comes a clipping of the Department of Civil Engineering's quarterly bulletin, giving some measure of Frank's success and munificence. He established a \$400,000 fellowship in 1989 and, quoting Department head David Marks, "expressed to me his love for MIT. Having no offspring of his own, he saw present students as his 'children' for whom he could provide the benefits of an MIT education. I tried many times

to convince Frank to visit MIT again to see what his contributions were doing, but he avoided the limelight and always refused our invitations. Recently we learned that Frank passed away in late summer of 1990. In his will he made a magnificent gift to the Department—an additional \$2 million of endowment for graduate student funding, thereby increasing the number of Schoettler Scholars from one to five each year." We can only add AMEN to this fine tribute.

In 1989, the Notes mentioned that **Ruth Humphrey Perkins** had Alzheimer's disease, and her page in the 50th reunion biographies was written by her sister, with whom she was living: "Since retiring in 1978, Ruth has been fighting with stoic determination the ravages of Pict's disease, related closely to Alzheimer's. She can no longer speak or write but still responds to the affection of her family." Now a letter from her daughter tells of Ruth's death on January 19, and an enclosed news clipping supplements the biography on her achievements. She joined our Course IV as a graduate of Middlebury College and subsequently earned a master's degree at University of Maine and a doctorate in math education at University of Michigan. Then she supervised teaching in New Hampshire, Vermont, and Massachusetts, and followed with training of mathematics teachers at University of Connecticut. Finally, as associate professor of math education at Temple University, she also designed a math laboratory. All of this was accomplished while raising a son and daughter—both achievers—despite being widowed since 1948. Some classmates will remember her attendance at our 40th reunion. Cheers for an outstanding life!—**Frank L. Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson**, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

## 37

### 55th Reunion

**Dick Young** reports that **Jack Robbins** was scheduled for knee replacement surgery. My wife, Rose Thorson, had arthroscopic knee surgery in early February. She is feeling fine and has permission from her doctor to play golf during our March vacation in Florida. Expect to see both Jack and Rose on the dance floor during our 55th reunion.

A recent listing of the class of 1937 sent by MIT contains the following interesting data: Nearly 60 percent of the class is retired; one member, **Joe Smedile**, is an MIT club president; three members, **Bob Ferguson**, **Joe Keithley**, and **Phil Peters**, have been awarded the Bronze Beaver; two members, **Rutherford Harris** and **Phil Dreissigacker**, have received the Lobdell Distinguished Service Award; two members, **Phil Dreissigacker** and **Walt Wojtczak**, have received the Morgan Distinguished Service Award. Golf is the #1 hobby, closely followed by gardening, tennis, and photography as #2; and also mentioned are computers, skiing, and fishing. Please respond to any correspondence you receive from your secretary and let us know of your hobbies, accomplishments, and interests.

A newly-formed organization has been established at the Institute for alumni widows, the Emma Rogers Society. Membership is automatic and is an example of MIT's wish that a widow of an alumnus continue to feel connected to the Institute and our class. The newly widowed will hear from the Emma Rogers Society in the near future.

I am sorry to report the death of **Joseph Dunning**. Joe was a retired aeronautical engineer, a McDonnell Douglas executive, and served four years on the Southern California Rapid Transit District board of directors. He was also on the board of directors of Long Beach Community Hospital and United Way, a member of the White House Conference on Youth, and past president of the Los Angeles Urban League. He is survived by his wife, two daughters, a son, and three grandchildren. Our condolences go to his wife,

Vivian, who resides at 7537 Mulholland Dr., Los Angeles, CA 90046.—**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890

## 38

Our April notes reported that **Hains Landen** had passed away in June 1990 and asked if anyone could supply more information. **Peer Cody** has kindly supplied the following. Prior to his entrance to MIT, Hains lived in Jamaica Plain, where he and Peer were neighbors. Hains attended Roxbury Latin School before entering MIT with our class. For some unknown reason, he did not complete the four years. During Peer's short stay in Cincinnati, he visited Hains in his CPA office. Peer closes with: "I enjoyed my early acquaintance with Hains and was very sorry to read of his passing."

I've had a nice note from **William G. Guindon**. He is currently librarian and treasurer of the Jesuit Residence, Loyola House, 300 Newbury St., Boston. There are 25-30 residing there at any one time, depending on the number of guests. He moved there in the summer of 1989—just 44 years after he first came there to begin his PhD studies at MIT. I knew he had been an undergrad with us (in Course VI-A) and had left the Institute after two years. He earned his MIT doctorate in physics under the renowned Vicky Weisskopf in 1948 and later studied and taught at Fairfield University (Connecticut), in Florence, Italy, was chair of the Department of Physics at Boston College, etc. But for years we've heard little from him, and I was not smart enough to figure why. It was that PhD! MIT computers don't think like class secretaries. Bill is still listed in all recent alumni/ae registers as Class of '38. Now I am guessing. As the computer systems have developed, Bill, I suspect the machine became blinded by that PhD of yours, assumed you got it in 1938, and therefore has been treating you as what the Alumni/ae Association calls G.S.E., meaning "Graduate Student Exclusively"—which includes thousands who attended for grad work only and generally have no identification with the SBs of that year. I'm sure that can be fixed. Welcome back into the class of 1938.

We have received an announcement of a preview at the Hyatt Gallery in Tipp City, Ohio, featuring the works of five artists, including **John Sullivan, Jr.**, a master in architecture in our class. Formerly a partner in the firm of Sullivan, Lecklider, and Jay of Dayton, he now spends much time traveling and painting: Europe all last summer, Caribbean cruise with his daughter in December, February visiting a sister in South Carolina, then to Venice, Fla., and finally on to Palm Beach for a reunion with three Delta Phi brothers.

**Cliff Nelson** is still busy with the Gorham Land Trust and the A.A.R.P. Portland Chapter Legislative Committee. . . . Had a note from **Arch Copeland**, who is living in Arkansas, promoting the application for admission for a young applicant wanting to study physics at MIT. (Arch, I called the Admissions Office before forwarding your letter of endorsement.)

Just received a honey of an announcement of *Crazy After Calculus*—an exhibition on humor at MIT. By coincidence, this exhibition has been made possible in part by the "humor" grant from our classmate **Peter De Florez**, and it is exhibited in the Margaret Compton Gallery made possible years ago by a gift from our class. Come before September 13!

Finally, it seems these notes too often end on the sad note of a classmate who has passed on. **William T. Tiernan, Jr.**, of Penn Valley, Pa., died November 27. Besides MIT, he had degrees from Haverford College and Cal Tech. A mechanical engineer, he held various positions with Catalytic, Inc., Franklin Printing Co., and Howard-Robinson Co.—**Don Severance**, secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley**, assistant secretary, 50 Spofford Rd., Boxford, MA

Anne and Fred Schaller developed admiration for keepers of genealogical records in western England. To research Anne's family tree, Fred and Anne made three trips to England where three bureaus carefully record births, deaths, and other items of historical significance. For a fee of about six pounds, they were permitted access to tidy and complete records containing exactly the information they sought. Fred said some of the records in that department pertained to events recorded in the 11th century!

Fred reports: "Henry Littlejohn bases his 41-foot Freedom sailboat near Baltimore and expects to cruise the Atlantic from there. . . . Don Timbie is retired in New Jersey after a career with Hewlett Packard." . . . At Easter time the Schallers were fully occupied at their Natick homestead with serving the community, their church, MIT, their family, and several racoons that, some years ago, came to dinner at the Schallers and liked it so much that they decided to stay.

Adie and Bill Pulver read *Surely You're Joking, Mr. Feynman* and recommend it as must reading for classmates. Bill and Adie attended a remedial golf school in Tuscon, Ariz. After graduating, they went to Aspen, Colo., where members of the 70-Plus-Club receive special privileges on most slopes. As soon as Bill and Adie report their new approaches to par for sitzmarks, we'll relay the good news.

Charles Mercer was elected president of the Audubon Society of Rhode Island. In retirement at his Little Compton home, Chuck raises vegetables, sheep, and spearheads execution of the policies of the Audubon Board.

I mentioned Hewett Phillips' prop-driven model airplane to George Cremer. George said some San Diego model airplane enthusiasts are designing jet engines for their model planes. The problems about compression ratios and developing 45 pounds of thrust appear solved. George said the next major challenge is to produce the tiny jet engine to sell for less than about \$200.

We are saddened by news of the death of John T. Francis December 28, 1990, at Burlington, Mass. There were no details.—Hal Seykota, secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 98335

## 40

Norman Klivans, class president, sent a note to the class officers about a mini-reunion in January 1993, in Naples, Fla. This get-together might include members of the classes of 1939 and 1941. Tentatively, it will be at the Naples Beach Hotel and Golf Club, from January 4-7, 1993. Further information will be sent to active classmates, along with a hotel brochure. Separately, the consensus for the 55th Reunion in 1995 is to go to Newport, R.I. after Technology Day.

Clifford H. Cracauer writes that he is still running his management and tax consultant business. Simultaneously, he is trying to keep up with his five kids, their respective spouses, 21 grandchildren, and three great-grandchildren, with two more "in process."

Unfortunately, we must report the death of Richard C. Brown on October 7, 1990, in Palo Alto, Calif. Dick attended the University of Washington prior to his graduation from MIT. He served as a lieutenant commander in the U.S. Navy during World War II, and was an active member of the Sierra Club for many years. He is survived by his wife, four sons, two daughters, a sister, 12 grandchildren, and one great-grandchild.

In addition, we are saddened by the passing of W. Kenneth Bodger of Laguna Beach, Calif., on November 13, 1990. After graduation, Ken worked at Pratt & Whitney Aircraft and Elliot Co. He then spent three years at Case Institute of Technology in Cleveland as associate professor of

mechanical engineering. After further manufacturing and consulting work with Carrier Corp., Ford Motor Co., and Keck Craig Associates, he returned to academe as associate professor of mechanical engineering at California State University, Fresno. Simultaneously, he served as VP and director of John Bodger & Sons Co. Ken had the privilege of encouraging two family members to attend MIT. He is survived by his wife, Gudrun, a daughter, and a son.

Albert Beucker of Melbourne, Fla., returned in February from service as a volunteer in Costa Rica with the International Executive Service Corps. He was recruited by IESC to assist a company doing rubber recovering of industrial steel rolls and drums with improving sales volume and quality control. He evaluated the implementation of improvements he recommended during his project with the company in September 1989 and continued to stress the importance of teaching staff how to solve problems using engineering and chemistry concepts.

Keep those notes and letters coming for inclusion in future columns.—Richard E. Gladstone, secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

## 41

At this writing, the calendar reads March 5, 1991—the deadline is March 29 for the July issue of *Technology Review*. Malcolm J. Abzug prompted this beginning. To see action on your memo takes a long, long time. Let me admit that the slowness of the class news is not only that the process takes a long time but that secretaries jealously guard what they rarely receive (like Malcolm's wonderful letter) for that day when the class file is completely empty. So I am saving Malcolm's letter for the next issue.

Major Robert H. Winalski, 72, U.S. Army retired, died December 23, 1990, in Alexandria, Va. He served in the 15th Air Force during World War II as a captain and flew a "Flying Fortress" B-17 bomber with the image of his infant son Bobby painted on its fuselage. Shot down during a mission over Germany, he was one of two survivors and spent eight months in Stalag 7A as a prisoner of war, finally liberated May 1, 1944, by the 14th Armored Division. Bob was a baker, and a partner in the former Newton Robertson Bakery of Wethersfield and Windsor with his brother and father. He was past president of the Connecticut Baker Association, and a member of the Connecticut Air National Guard. He also headed former Governor Lodge's military staff. He leaves his wife Marlu, a son, and a granddaughter.

George H. Palmer, Jr., retired from American Bureau of Shipping, sent this note to Ivor Collins. "In our serious days (1936-1941), I had an almost fatalistic unconcern about what the future may have in store for us. Suddenly here is the 50th reunion and I still have the feeling that the future is beyond my control. Nevertheless it has been a full and pleasant life getting this far and I have no regrets." Ivor also forwarded a note from The Phoenix Nest, in Wonalancet, N.H., the summer residence of Bill Hargens: "Greetings from the White Mountains of New Hampshire. We are located at a remote and quiet spot, the beginning of the trail to Mt. Whiteface. No cars, just bikers pass our door. Great time of the year here through September, when we go back to Philadelphia. Pipes freeze then, and the house plumbing must be drained."

I suspect that when Bill reads this note, he will be back in New Hampshire, which will give you proof of the ultimate timeliness of these pronouncements.—Joseph E. Dietzgen, secretary, Box 790, Cotuit, MA 02635

## 42

Though it seems a long time off, Jack Sheetz has started work on our 50th Reunion Yearbook. It is

## 50th Reunion

a huge job, and Jack wants to put out the best yearbook ever. He can do that only if we all help by getting his March 8 questionnaire completed and back to him as soon as possible. SO DO IT NOW!

We've visited with Hazel and Fred Gander who winter in Dunedin, just north of here (Clearwater, Fla.) . . . Francine and Jim Stern stopped in for a few days of golf and bridge last week. They were on their way home from their annual visit to the Sun Spa in Hollywood. Both looked healthy and terribly trim! . . . Bob "Hawk" Shaw is still contributing items to and acting as a goad to varied medical and health organizations; the latest, an article in the National Health Federation's bulletin.

From Jack Sheetz's letter; he retired in 1979 but keeps busy consulting on computer systems and developing computer software. Jack has become serious about his longtime interest in magic and now performs as a "street magician" which is the most demanding form of magic. He is not getting rich from the contributions his enthusiastic audiences throw in the hat but is surely having lots of fun with it. . . . George Toumanoff took an exciting trip trekking in Nepal just in time to catch the peak of the revolt against the king there. He reports that it was "a bit spooky but all went well." From the letter, I'm not sure whether he was for or against the king!

Three obits: Art Knudson (we missed this one in 1986), Marsh McGuire, and Jim McClelland. Our sympathy to their families.

Let's hear from you and do let us know what activities you'd like to have included in the reunion.—Ken Rosett, secretary, 191 Albemarle Rd., White Plains, NY 10605

## 43

The only news item I have this month is an obituary. Bill Voorhis, (Course XV), of Roswell, Ga., died in April 1990. This is a painful personal loss to me, because Bill and I were close friends in our undergraduate years. I am saddened by the thought that we will not be seeing him at the 50th reunion. He is survived by his wife, Ruth, to whom we extend our condolences.

The reunion wheels continue to turn. The location has been selected, the scenery is being assembled, and the players are rehearsing their parts. Stan Proctor and crew are busily recruiting angels and backers for the show. The curtain goes up in only two years, so don't put off until the last minute making your plans to attend. Meanwhile, send more news.—Bob Rorschach, secretary, 2544 S. Norfolk, Tulsa, OK 74114

## 44

Marty King and family had a very exciting year in 1990. In early June, they flew in his Cessna Twin from their Daytona Beach Fla., home up to Patterson, N.J., for his 50th reunion at Eastside High School (*Lean on Me* movie fame). Then they flew up to Boston to visit Donna and Chuck Hieken, '51, and got caught up on changes in the Boston area during the last 50 years. It was extremely nostalgic. In August, Anne Ida and Marty flew to San Jose, Calif., for their son Dick's (MIT '72) 40th and eldest granddaughter Trudy's 16th birthday. On the way they stopped for a few days in New Orleans, San Antonio, Carlsbad Caverns, Tucson, and San Diego, where they spent a most pleasant visit with Anne and Bob Plachta. They came back by way of Prescott, Ariz., San Angelo, and Mobile. Marty was overwhelmed by the physical beauty of our great country and the distinctive attractiveness of each region. In October, he entered the hospital for a long-needed back operation from a 1950 injury. After over four hours of surgery and several months of recuperation, he is coming around. He is looking forward to a mini-reunion and will fly anywhere to attend. A mini-reunion is in the

planning stage and you should receive details long before these notes arrive.—co-secretaries: **Andrew Corry**, P.O. Box 310, West Hyannisport, MA 02672; **Louis Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

## 45

**Luigi J. Russo** of Springfield, Pa., died on November 30, 1990. We recently received a letter from his widow, Nancy, indicating that Luigi was very proud of his MIT degree and his beaver ring. Russo received a master's from University of Pennsylvania in 1954 and had completed all his doctorate requirements shortly thereafter but never completed the necessary dissertation.

**T.R. "Pete" Hickey's** wife Lou—or should I say Louise Furber Hickey—passed away on February 23 after struggling a year with lung cancer. If memory serves correctly Lou was the only non-Tech undergraduate to have been formally afforded membership in the historic P-Club, that senior year beer drinking group that met each Saturday afternoon at what is now part of the Somerset on Commonwealth Avenue.

Through the years we have often read of **Emily "Paddy" Wade's** MIT activities. A recent article in the *Lowell Sun* described the Bedford, Mass., environmentalist's interests in museums, literacy, and teaching. Paddy served on the Bedford Conservation Committee for eight years and was its first chairperson at the time it was established in about 1960.

During Paddy's 22 year stint on the board of the Boston Zoological Society she spent considerable time running the loose management contract the Society had with the MDC at the Stone Zoo in Stonham and the Franklin Park Zoo in Boston. Since 1986, Wade has been committed to the Museum Institute of Teaching Science (MITS), an association of 11 museums in eastern Massachusetts that operates under a grant from the National Science Foundation. She has also been an active member of the Audubon Society, the Boston Adult Literacy Board, and the International Council for Bird Preservation in Cambridge, England.

Help, we need news!—**Clinton H. Springer**, secretary, P.O. Box 288, Newcastle, NH 03854

## 46

Another year—another year of MIT students supported (in part) by our class of '46 Scholarship Fund. The four newcomers include: **Christopher Wren**, a sophomore from Stow, Ohio, who is pursuing computer science and does research in advanced human interface with the media lab. He also works out on the ergometer, plays inter-mural football, ice hockey, and softball. **Sarah King**, a senior from East Brunswick, N.J., is majoring in management in the health field. She is very active in community work, e.g., the blood drive, Unicef projects, and publicity for the lecture series. Her writing and research involved working with native Japanese speakers. **Makie Tam**, a sophomore from Linden, N.J., is working on her Course IV architecture SB. She carried a heavy load in her freshman year but is still on track. Last summer she did product research for Exxon Engineering. **Suzanne Choe** wrote our **John Gunnarson** a nice letter about her sophomore year studying biology in preparation for medical school. She is motivated by the loss of her father last year. "I realized just how personally significant privately endowed generosity could be." . . . So our contributions were greatly appreciated.

Then in February I received a note from **Bob Hoffman** (yet another North Jerseyite) asking if I could fill in some blanks in our records of reunion chairs and presidents of our class over the early part of our 45 years. After a fair amount of research and several phone calls to eastern climes, I tossed it in and sent a letter telling Bob

to try **Jim Goldstein**, our "president emeritus," who lives pretty close to him. I wished him well and hoped to know more in October at Kiawah. . . . Speaking of the reunion, I got a note from **Jim Chabot** and a call from **Bill Cahill** expressing interest in details of the 45th. By the time you read this you will surely have everything you ever wanted to know about schedules and prices at this South Carolina seaside resort. But the real surprise came in a phone call from **Bill Lucero**, whom I've never written about, partly for lack of background. But I found him in the "bio book," revealing that Bill survived the electrolysis in Course VI as well as the V-12, in the September group. He married Barbara shortly after graduation and made the "big cruise" with lads such as **Ted Heuchling**, et al., followed by another 12 years in the USN and another 25 years in the USNR, and finally retiring in 1985. Along the way he sired two boys and a girl. During the years he worked on small, then big, missiles at Redstone, and then, for 20 years, with NASA at Marshall Space Center. Yes, he still lives in Huntsville, with which you may be familiar. He loved it all the way. Turns out we have common interests, and he is planning a trip to Salt Lake with the possibility of stopping by Denver (probably before you read this.)

Toodle-oo, stay well, come visit!—**Jim Ray**, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

## 47

Let's start this month with the story of the 21-year-old wife, the Rolls Royce, the year-old daughter and the son with the Harvard MBA who helps at the office. Have we got your attention? Here's a delightful letter we got from **Henry Lee** recently to offset the retirement notices we've been publishing: "In the summer of 1946, I visited California with friend **John Maxfield** (Course XVIII) and decided I wanted to live there, particularly in the Pasadena area. I made it to California by 1951 and, after a stint designing rocket engines at Rocketdyne, I started a chemical company (that makes, among other things, Lee Press-On Nails™) and have been living the quiet life of the little old man from Pasadena. I drive a 1991 Cadillac to the office. Being out in the provinces so to speak, I don't wear a tie. I wear tennis shoes and drive a 25-year-old Cadillac convertible on Saturday. On Sunday outings, I drive a 10-year-old Rolls Royce. I browse the Milken library at Caltech down the street and attend affairs at the faculty club by virtue of a hard-earned membership card. I have a condo in Waikiki, and a thoroughbred ranch up north where I ride a bit and collect old tractors and trucks.

"I have two children and four grandchildren, the youngest grandchild being 20 years old, by my late wife, Ria. Unfortunately, she died of cancer four years ago. I recently married (on the occasion of the 86th anniversary of my grandfather's and the 114th anniversary of my great-grandfather's weddings) a rather younger woman, Rita (age 21), who rides hunt seat with my daughter and granddaughter. We have a one-year-old baby girl, Megan Amy. I have no urge to retire and, because of my life-style, probably could not afford it. I find that a Macintosh and FAX machine (with carrying cases) give me a new degree of freedom from the office, per se, though having a son with a Harvard MBA at the office as backup is not all bad."

The American Physical Society presented the 1991 Biological Physics prize to **Watt W. Webb** of Cornell University "for his seminal work on the biophysics of cell membranes and cell motility, for his dedicated training of future generations of critical biophysicists, and for his long-standing contributions to the biophysics community." I remember Watt; he and I were on the MIT rifle team in the days when we could (and did) beat any school except the service academies—and we came close to them! (I have to confess, though, Watt was a better marksman than I.) **Kevin Lynch**

## 45th Reunion

has written a new book, *City Sense and City Design*. It is an invaluable sourcebook of design knowledge, says the publisher. This book "completes the record of one of the foremost environmental design theorists of our time and leads to a deeper understanding of his distinctively humanistic philosophy."

Recently, we attended an affair sponsored by the MIT Club of Denver and met **Ted Davis** there. He is retired and living in the Denver area.

We also have a number of deaths to report this month. **Claude Brenner** reports that **Hugh Byfield** passed away sometime last year. . . . **Arthur W. Galusha** died December 13, 1990. He was living in Charlottesville, Va., and is survived by his wife, Mary Nicholas Spinazola Galusha, who is originally from Framingham, Mass. (small world—we knew her sister slightly when we lived in Framingham in 1950).

**George L. LaPerche** died last January 30 in Boston. He had lived in North Reading, Mass., for 41 years and is survived by his wife, Ruth, a son, and two daughters. George worked for General Electric in Lynn, Mass., for 38 years and retired in 1985. . . . **Michael T. Rosar** died on November 11, 1990. He is survived by his wife, who lives in Oldsmar, Fla. . . . **Ted Davis** informed us that **Joseph D. Stout** died in December 1988. He was retired and living in Alcoa, Tenn., at the time.—**Robert E. McBride**, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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The mailing for our September 27-28, 1991, Martha's Vineyard reunion was sent out in early February and responses from 22 classmates have been received. On April 4th, the hotel had deposits from 12 classmates.

**Al Baum** is coming to our September reunion with his new wife, Ruth. They met at a support group after Al lost his first wife to cancer, and Ruth lost her husband. They found each other to love and behold and they each became more complete.

Al is "working" for U.S. Department of Labor, Occupational Safety and Health Administration, as a safety engineer. He was in Washington and Houston last winter helping to analyze the Phillips Petroleum disaster and to prepare a report for the President—but other than that he just performs routine inspections in Bergen and Passaic counties, New Jersey.

**Frank Iskra** retired from Proctor & Gamble, R & D, three years ago and is enjoying it! In June 1988, Frank married Dot Chapman in Cincinnati at their church where they had met. Frank has treasured the happiness they have shared. Frank and Dot spend much time gardening and particularly enjoy the roses. They do a lot of dancing—ballroom, square, and round; and enjoy golf, even though they find most of the traps. They are currently co-presidents of a large social group at church.

Frank reflected on the many blessings he has received. One he really cherishes is his education from MIT and hence is pleased to have been able to help MIT with some of its needs. Frank served on the Educational Council and was chairman of the Cincinnati region for 27 years. This was a very rewarding experience. He headed a Special Gifts Drive in his region during MIT's Campaign for the Future. Both he and Dot look forward to attending the September reunion on Martha's Vineyard and seeing Frank's classmates. It will be the first time Frank attends a reunion of the Class of 1948.

**Al Weis** hosted a luncheon at the Midway Club with speaker Bob Solow, a Nobel laureate and professor of economics at MIT. We are fortunate that Professor Solow will also make a presentation during our Reunion on Martha's Vineyard in September. Those attending can expect to become familiar with a wide range of economic issues.

**Mike Oglo** is planning to attend the September

reunion. Mike retired from Stromberg Carlson where he was a patent attorney and legal counsel on licensing and corporate negotiations. He has joined the Navy's Underwater Lab (formerly known as the Torpedo lab) where he is doing patent work. Mike attained the rank of captain in the Navy Reserve. He and his wife, Marilyn, live in Florida where Mike enjoys board sailing.



John Randolph

**John Randolph** joined Bank of Boston's Finance Group. He will serve as an advisor to the corporation's CFO. John founded and ran Randolph Computer Corp., a computer leasing firm that became a public company in 1966, merged into the Travelers in 1969, and in 1972 was acquired by BancBoston Leasing, the leasing subsidiary of Bank of Boston Corp. After selling his company, John served as an advisor and private investor for a wide variety of enterprises, including Data Switch Corp., State Marine Corp., Boothe Financial Corp., and HEC Energy Corp. In 1983 John received a master's in humanities from Manhattanville College. He serves on the board of trustees at the Dana-Farber Cancer Institute in Boston. John and his wife, Kathleen, are relocating to Boston from their home in Greenwich, Conn.

**Mike Kami** presented a forum for top management on Management Strategies and Corporate Planning. The forum was sponsored by AMA and held in Fort Lauderdale. Mike continues to receive acclaim from experts like Tom Peters, **Vaughn Beals**, and J.V. White, CEO of Equifax.

**Emory Mikell** is in the process of closing out a business he operated after he retired from the Army. He is looking forward to being fully retired and plans to spend more time playing golf, fishing, and reading. . . . **Ken Stickney** retired in July after 43 years with Fibre Leather Mfg. Corp. in New Bedford, Mass. He has been technical director, chief chemist, and purchasing agent for the past 30 years. . . . **Dan Fink** was appointed director of M/A-Com Inc in Burlington, Mass. . . . **Roy Simm** retired from Sterling Electric Motors and is living in Whittier, Calif.

**Bill Revoir** died after a long illness. An Army veteran, he served in World War II. He was director of safety products research and development at American Optical Co. for many years, then held the same post at the Los Alamos Scientific Laboratory. He later became vice-president of research and development for Welsh-Textron. After retiring, he was a consultant. He was a member of the American Industrial Hygiene Assoc. and the American Chemical Society. He served as chairman of the respiratory committee of the Atomic Energy Commission. On behalf of our classmates I extend our sympathy to Bill's wife, Lois, and his family.—**Marty Billett**, secretary and president, 16 Greenwood Ave., Barrington, R.I. 02806, (401) 245-8963

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**Ken Prytherch** writes: "Dear Fletcher, I was somewhat surprised to see there were not class notes in the February/March 1991 issue of *Technology Review*. Upon reflection I imagine it's because no one is taking the trouble to write you!"

In reply, I say: "Dear Ken, Your letter warms my heart and yes, for the February/March issue I had absolutely nothing in hand to write about. I hate to miss a column and was tempted to submit a chapter from my unpublished (also unwritten) memoirs. But I'm not sure the class is ready for anything like that."

Ken continues: "If you need some filler, I offer the following: Recently I was appointed (read nonpaying) to the Franklin Lakes (N.J.) Planning Board. I had been on the Shade Tree Commission and the mayor felt I was ready for bigger challenges. Little did I know what I was getting into. At my first meeting (which didn't adjourn until 1 AM) two lawyers got into a shouting match and then the Planning Board members joined in and general chaos prevailed. . . . I am keeping up with my bird-watching activities to stay on an even keel as I sail into the Golden Years."

**Shirley and Chuck Holzworth** write an annual newsletter to old friends and this year Chuck sent a copy to me in the quite correct assumption that I welcome news about any of you. The letter is most thought provoking and I therefore submit a generous selection of excerpts from it.

Daughter **Bobbie** was made a partner of her law firm and is specializing in employment and labor commercial litigation—a lively practice.

By way of recreation, **Chuck and Shirley** took a Caribbean cruise, toured Alaska, and cross-country skied in Colorado. At home in Rockford, Ill., they concentrated on local causes.

**Chuck** is active as a School Board, Hospital Board, and Symphony Board member. The challenges facing these three organizations are quality education, control of medical expenses, and survival of the arts.

**Chuck** finds participation on the School Board stimulating and a real challenge because, just for starters, income is increasing 3.5 percent per year while expenses increase 5.5 percent. To date, **Chuck** has concluded that major causes for relatively poor performance in education are state mandates, union contracts, special-interest groups, a costly solution to asbestos brought about by panic, a bilingual program that insures a Hispanic will be a dishwasher, and a complex system to which the public wants simplistic answers and cheap, quick cures.

**Chuck's** hospital activity has focused on capital appropriations and finance. One of the problems is that Illinois is out of cash and reimbursing hospitals 63 percent on their costs 120 days late. This forces the hospital into the role of banker and social agency. Technology is improving at an exponential rate, which is one of the reasons why there are literally not enough resources to maintain a general hospital. "So," says **Chuck**, "we are identifying specialties in order to concentrate available capital dollars and survive."

In the arts, **Chuck** comments: "The Rockford Symphony is similar to other arts in our community—higher costs with decreasing available sponsorship. There are adequate monies but the formal arts (symphony, ballet, and drama) are losing to other forms of entertainment. Our traditional audience is aging and the younger generation needs a lot of coaxing toward 'culture'."

Concluding, **Chuck** says: "Although my consulting and civic activities take much more than a 40-hour week, I am enjoying both. The consulting presents an opportunity to work on start-ups, turnarounds, and new ventures without day-to-day pressure. **Shirley** and I are playing tennis and cross country skiing regularly. We are in good health. . . and look forward to 1991. We hope you are well and enjoying life."

Starting in 1988, **Lachlan Blair** became professor emeritus of Urban and Regional Planning at the University of Illinois at Urbana-Champaign. He is now in a private consulting practice as president of the URBANA Group. In 1989, he received the "Distinguished Professional Planner" award from the Illinois Chapter of the American Planning Association. This year he has been named "Distinguished Illinois Preservationist" by

the Landmarks Preservation Council of Illinois. **Lachlan** is one of those people who knew early exactly what he wanted to do, for I notice in the yearbook that he majored in city planning.

Another man who stuck with his major (business and engineering administration) is **Angelo Arena**, who has retired as chairman and CEO of Marshall Field & Co. in Chicago.

On Monday, March 25, the Reunion Committee met at the Faculty Club to discuss returns from the mailing I sent out regarding the September mini-reunion on Martha's Vineyard. However, as we were about to sit down, the fire alarm went off. It must have been the latest thing in eardrum splitters because if a jack hammer had been going full blast in our small dining room, we still would have heard the alarm. An elevator motor had caught fire. So, down six flights of stairs we went and out into a chilly wind to stand around (**Russ Cox** with no overcoat) while all the firemen in eastern Massachusetts swarmed into the building. After 45 minutes we were permitted back in and the meeting resumed.

As of the meeting date, those who had sent deposits to the Harborview Hotel where the reunion will be held were **Betty** and **Bob Griggs**, **Jean** and **Harry Lambe**, **Pam** and **Micky Ligor**, **Betty** and **Ira Dyer**, and **Sonya** and **Frank Hulsmit**. **Marjorie** and **Dave Moore** aren't sure yet but hope to attend. Same goes for myself and **Nell**.

On the back of the questionnaire that **Bob Griggs** returned, he wrote from San Juan, Puerto Rico: "Busy as ever with my law practice but am also one of the founders of an airline: The Virgin Islands Seaplane Shuttle—successor to a totally unrelated airline that was wiped out in 1989 by Hurricane Hugo. We have our DOT and FAA certificates and are about (March 1991) to start scheduled service! On a personal note, **Betty** and I had our 16th grandchild in October, and we're expecting number 17 next October."

On the back of a second questionnaire, **John Alger** writes from Rumney, N.H.: "Retirement is more work than working! My wife and I are both SCORE (Service Corps of Retired Executives) volunteer counselors and I am town moderator on the Conservation Commission Planning Board and Advisory Board. In addition, this year I'm president of our lake association and our church group. While I'm trying to save the lakes, my wife is working on the rivers. Don't retire! It's too much work. But here in the woods, we enjoy visits from our two granddaughters by my son **Monty** (MIT, '78) and his wife **Anne**. It's an active life and really lots of fun."—**Fletcher Eaton**, secretary, 42 Perry Drive, Needham, MA 02192, (617) 449-1614

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Please send news for this column to: **John T. McKenna**, secretary, P.O. Box 376, Cummaquid, MA 02637

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Our long-awaited 40th reunion will be a pleasant memory by the time this issue is in your hands. I hope you were among the fortunate members of our class privileged to have been there. Since this article is being written in March, I'll have to wait until the next issue to attempt to describe the wonderful experience I am sure it was. For those who were there, my description will be superfluous; for those who could not make it, my description will hardly do it justice other than to possibly begin to whet all our appetites for the forthcoming 45th.

New Jersey ranks second in the nation in the patents per capita. The New Jersey Inventor's Congress will shortly be opening a Hall of Fame honoring its notable inventors. Newly inducted into this notable group that includes **Albert Einstein** and **Thomas Edison** is our own distin-

# Morton Grosser, '53

## The Writing Life

A conversation with Morton Grosser, '53, can be an exhilarating experience. His output in a variety of fields is downright inspirational. He is so personable, moreover, that you might find yourself exchanging intimate secrets with someone who had been a total stranger 30 minutes ago.

Grosser's success, like that of other overachievers, seems to rest on a rigorous schedule. He runs a management consulting company that advises Fortune 500 corporations and also helps small high-tech firms get off the ground. In addition, he has a research partnership at the Stanford Medical School. Among other activities there, he co-founded the Microelectronics Axon Processor (MAP) project, which involves the repair of damaged nerves with implantable microchips. By his reckoning, these two endeavors account for 60 percent of his time.

Grosser continues to set aside 20 percent of his working hours for fun projects like the *Gossamer Albatross*, a milestone in human-powered flight. His wife Janet, also '53, joined him on the team that engineered the first human-powered air crossing of the English Channel in 1979. Nowadays, Grosser's fun might include acting, TV and film directing and producing, sharing Janet's passion for promoting dance (and dancing), working out, and his numerous inventions, such as the "gravity-powered rollway," and a "reconfigurable world globe"—both patented.

In 1981, Grosser wrote a book about the flight over the channel, *Gossamer Odyssey*, and writing takes up the remaining 20 percent of his budgeted time. Last year, Grosser's seventh book (and third novel) was published, *The Fabulous Fifty*, a whimsical account of the 1921 World Series. He heard part of the story from his father, who had been a friend of baseball legend Connie Mack. Grosser invented all the characters, but maintains that the baseball details are true. He recently finished his next book, a mystery nov-



el, and more are in the works. I called him at his home in California, and he talked about how he got started in business.

As an MIT undergraduate, Grosser began writing for *The Tech*, *Voodoo*, and *The Tech Literary Supplement*. He had a couple of wonderful English professors who "encouraged literacy at a higher level than industrial prose," he remembers. "But I had to squeeze the writing in." Classes ran from nine to five, Monday through Friday, and on Saturday from nine to noon. There were no electives.

"Back then, we were starved for the humanities at MIT," Grosser reports. (Making sure he could hold his own with high school buddies who graduated from Harvard and went on to jobs like head of the comparative literature department at Princeton was also a motivator.) He began dating Janet, one of nine women in their class of 949, when they were students. Together, he said, they spent a lot of "stolen time—that is, time we should have been doing problem sets for physics," going to art museums and plays. They also drew up the syllabus for the first subject in

non-Western literature offered at MIT. The late Bill Greene, remembered by present faculty as a scholar of wonderfully broad taste who "would teach anything," continued offering non-Western literature for many years after the Grossers prompted him to start.

After both received master's degrees from MIT in 1954, the Grossers headed to Stanford, where Morton began graduate work in the history of science. While working on his first book, *The Discovery of Neptune*, an offshoot of his doctoral thesis, he thought of the last line of a short story. He wrote it down. After finishing the science book, he "used up the momentum from that" to write the story, which concerned a tweed weaver on an island in Scotland.

He sent the story to the *New Yorker*. "I didn't know the first thing about the writing world," he says. "I didn't know the story was supposed to be double-

spaced. I didn't know about the proverbial 'self-addressed, stamped envelope.' I just sent it off, and they bought it. I thought, 'this is cool. No research, no formulas, no translations.'"

At the time, Grosser had finished a post-doctoral fellowship at UCLA and was living a bohemian lifestyle at Stanford. That, of course, meant playing frisbee every night with writer Ken Kesey. Kesey had been a Stegner Fellow and encouraged Grosser to apply to the program—the largest creative writing fellowship in the United States. Grosser entered the competition and won, and Wally Stegner, the program's head, became his mentor, opening him up to a whole new world. And he's been writing ever since.

Writing skill is not an insignificant asset in business, and Grosser receives numerous comments on his clear, literate memos. "The most complimentary thing you can say to a mathematician is the same thing you can say to a poet," he observes. "Not whether the thing was right or not, but that it was elegant." □

STEVE NADIS is a Technology Review contributing writer.

guished classmate, Dr. **Anthony Kurtz**. Tony is the president of Kulite Semiconductor in Leonia, N.J. He has over 50 patents in the field of piezo electric sensors, which very sensitively measure pressures used widely in applications from blood monitoring to fuel pressures in aerospace vehicles. Every GM vehicle has one or two of them. Tony started his business in 1960, and it is currently a \$35 million organization.

Following his retirement in March 1989 after a 29-year career at Bell Laboratories, **James McKenna** has joined Bellcore as manager of the Systems Principles Research Division.

We received the unfortunate word from **Lew Tedeschi** that **Richard W. Mascold** passed away in January 1988. Richard was employed by the Aerospace Corp. in El Segundo, Calif., in their Propulsion Department. We wish to express our very belated condolences to his family.

We also received news of the passing of **John W. Wassel** in July 1990. Our sincerest sympathy is extended to his wife Helen, who is currently living in Miami, Fla.—**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368

## 52 40th Reunion

This year **Art Freeman** submitted (only!) ten papers at the March meeting of the American Physical Society, down markedly from his recent rate. Many of them seemed to be about computations on high temperature superconductors. Other classmates are also slowing down, or looking forward to it. . . . **Clifford Sayre**, currently VP of DuPont Materials, Logistics, and Services, says he is looking forward to retirement at the end of 1992. . . . **Robert Norton** is now semi-retired, devoting more time to his 17 grandchildren (with more expected) and his wife of 39 years, Ginny.

I am saddened by news of four recent deaths of classmates. **Paul Przybylek**, 73, died last February 1, 1991. He had retired from the U.S. Naval Air Development Center in Warminster, Pa. He served in the Army in World War II. He is survived by his wife, Catherine, two brothers, and two sisters.

**Michael Green** died June 29, 1989. At the time of his death, he was president of a real estate and investment firm in St. Augustine, Fla. For 21 years before his retirement in 1979, he had been in the commodity futures trading industry. He is survived by his wife, Kristine, his parents, two sons, two daughters, and four grandchildren. His wife writes that Michael's education was the foundation of a successful and happy life, and the family hopes that a grandchild will follow in the footsteps of Michael and Michael's father by attending MIT.

Another Michael, **Mike Duggan**, who taught at San Jose State University, died November 2, 1990. His family writes, "He had suffered horribly from recurring disabling depression and, during October, from lung cancer that had spread to his brain. We will miss his gentle nature, his nurturing, his integrity, his fine mind, and his humor." He is survived by his wife, Lynn, and three daughters. . . . **William Holden** of Concord, N.H., died August 28, 1990. He is survived by his mother.—**Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301

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Please send news for this column to: **Gilbert (Gil) Gardner**, secretary, 1200 Trinity Dr., Alexandria, VA 22314; (703) 461-0331.

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A welcome letter from **Dean Jacoby** informs us that he has spent the past few years in the throes of launching a new business, Chrysalis Investments, Inc., and that endeavor has kept him rela-

tively out of touch. He has now gotten the company well on the road to success and, according to his January 1991 newsletter, the Chrysalis Composite Portfolio has outperformed the S&P 500 Index in 25 of the 36 months from January 1988, through December 1990. Dean "utilizes probability theory in forecasting the probable market valuation of individual stocks." He operates out of University Place in Cambridge and welcomes new clients.

We have learned that **Frank A'Hearn**, who formerly ran his own business in Concord, Mass., has been appointed building commissioner for the Springfield, Mass., Building Department. . . . Let us hear about your latest achievements. The class is interested.—**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Ln., Fairfield, CT 06430

## 55

Our esteemed classmate, **Duwayne J. Peterson, Jr.**, has announced his retirement, effective June 1991. Duwayne was formerly executive vice-president of Merrill Lynch & Co., in charge of their operations systems and telecommunications, and very much in the news as a leading light in the use of information technologies for strategic business purposes. He joined Merrill Lynch in 1986, having previously held a similar position at Security Pacific Corp., and now plans to return to California. Duwayne has also been very active in MIT affairs as a member of the Presidential Search Committee and now serves as chairman of the Sloan School Board of Governors.

**Gerald Maloney** has moved up in the world, having been promoted to executive vice-president of American Electric Service Corp. in Columbus, Ohio. Gerald has been senior vice-president—Finance for the company since 1975. He is also chair of the board of Energy Insurance Mutual Ltd. and is a director of Nuclear Electric Insurance Ltd.

**Ashton Stocker** sent in a much welcomed note informing us that he has formed a new company, Biometrics, Inc., offering process engineering, facility design, project management, and validation services to biotech companies in the New En-

gland area. Prior to this, for seven years he operated a consulting business serving biotech companies with facility management services. Ash says that biotech companies make great clients: they have very bright, highly motivated people and are fun to work with.

**Gilbert Strang**, professor of mathematics at MIT, adds yet another textbook to his impressive list of publications. His book *Calculus*, published by Wellesley-Cambridge Press in January 1991, is a basic three-semester text for calculus designed to be highly readable for students, with many examples and graphics. I wish we'd had something like that!

We are sorry to have to very belatedly report the death of Professor **William B. Nicoll**, who died in June 1978. William was in the special honors class of 1955.

News is starting to get thin! Let us hear about your promotions, retirements, awards, personal exploits, whatever.—Co-secretaries: **Roy M. Salzmann**, 481 Curve St., Carlisle, MA 01741; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21043

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The 35th Reunion is only two months away; trust most of us have made plans to attend. Both class secretaries will be there, on the usual expense account, to take prepared statements for future editing. (**Irwin Gross** will make a tour of the site of "Bonfire of the Vanities," on the way, to provide us with the latest update of the scene.) Other dignitaries, such as the president, VPs, reunion chairs, and committee members, etc. will be there at "untellable" expense. Then, of course, the stars shall be there: *You*.

**Paul Abrahams** published his first book this year, *TEX for the Impatient*. . . . **Oscar P. Manley** continues to manage a small (\$15 million/year) engineering research program at the U.S. Department of Energy. Topics include fluid mechanics, solid mechanics, robotics, chemical process control, optics, non-linear systems, non-equilibrium phenomena, etc. At the same time, Oscar has continued his own research on the mathematic theory of turbulence over the past ten years, averaging about one paper per year. . . . **Bob Scher**, president of Teledyne Gurley in Troy, N.Y., continues working hard and is enjoying it. Audrey and Bob have become chamber music enthusiasts; they go to over 100 concerts a year within a 125-mile radius of Albany.

**Andrew J. Viterbi**, vice-chair and chief technical officer of QUALCOMM, Inc., and professor of electrical and computer engineering at the University of California, San Diego, was recognized by three organizations this past year. He was presented the Marconi International Fellowship Award by the Science Advisor who, in President Bush's words, thanked Viterbi for clear and easy-to-use communication devices. "Our Nation is fortunate to have such talented and dedicated scientists, whose contributions not only provide marvelous inventions for society but also play a vital role in helping the United States maintain its competitive position in world markets." The second honor: Viterbi was the engineering commencement speaker for and recipient of an honorary doctor of engineering degree from the University of Waterloo, Ontario, Canada. He was introduced: "We honour him today as much for his far-reaching technical contributions as for his leadership in engineering education." Viterbi was also selected to deliver the Shannon Lecture at the 1991 International Symposium on Information Theory held in Budapest, Hungary. It is the highest recognition bestowed by the IEEE Information Theory Society.

**George Brattin** continues to work as an "expert" in building code matters. He also does some small repairs and rehab on his two properties as time permits; doing hands-on work looks like fun, similar to working with concrete, until you have to do it. George was recently anesthe-



Before

After

*Miracle Treatment Restores Hair Color . . . Either that, or we inadvertently switched the photos of Fred Brecher, '53, and Marsbed Hablanian, '55, on page MIT 22 in our April 1991 issue. Our apologies to Fred on the right, Marsbed left.*

tized into the post-verniform appendix age. He stoically carried the ruptured item around for about four days before seeking medical attention. In his defense, he never claimed to have graduated at the head of the class. (He will probably still be trying to avoid unpleasant tasks, based on the operation, as proof he didn't graduate at the bottom.)

Will we still love you in September? You bet! See you then.—Co-secretaries: **George H. Brattin**, 39 Bartlett St., Andover, MA 01810, (508) 470-2730; **Irwin Gross**, Sweets McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

## 57 35th Reunion

Please send news for this column to: **John Christian**, secretary, 23 Fredana Rd., Waban, MA 02168

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In March, we received a delightful note, post-marked Hong Kong, from **Richard Glantz**. He writes, "Just wanted to let you know that in June 1990, I married Judy Palmer, whom many of you met at the 30th Reunion. We have now moved out here to Hong Kong, where I head up Asia Engineering for Digital Equipment Corp. The children come out several times a year to visit during school vacations. That's when we discovered that 20-year-olds no longer listen when exhorted to clean up their rooms, get a haircut, or take a shower.

"Not only did we have to learn Cantonese to survive in Hong Kong but also Colonial British. For example, 'take the tram' means 'take the trolley' and 'take the trolley' means 'take the shopping cart.' We used paper towels at the dining table for months until we discovered that here they are called 'serviettes'.

"The Hong Kong work week is arduous—Monday through mid-Saturday—so we guard our free time together. Judy and I have been hiking extensively on the network of trails here on Hong Kong island. With the heat, the climbing can be onerous. But we are continually refreshed by the perfume from the flowering shrubs which keep us on course. Begonias, Camellias, Lantana—what a delight! No wonder they named this place Hong Kong, or in English, Frangrant Harbor." For any classmates visiting Hong Kong, Richard and Judy are living at Tower 13, Apt. 1775, 88 Tai Tam Reservoir Road, Hong Kong.

That's all folks! Send more Merrie Melodies for next month's column.—**Mike Brose**, secretary, 1619 Greenleaf Blvd., Elkhart, IN 46514, (219) 264-4838

## 59

Please send news for this column to: **Allan S. Bufford**, secretary, Office of the Treasurer, MIT, 238 Main St., Suite 200, Cambridge, MA 02142

## 60

**Gerald Hurst** writes that he was married in November 1989, and in combining households was even able to sell his house. So congratulations, Gerry, on both momentous events! Gerry is still a professor at Wharton and is still working to get a software company off the ground. He also wrote that, while he sees lots of MIT folks, few classmates are among the faces. (Sounds like an open invitation to '60ers who are in the Philadelphia area.)

Also sending along some news is **Joseph Catanzaro**. Joe, who made it to the 30th reunion, lives in Franklin Square, N.Y., where he is a lawyer specializing in intellectual property, including patents, trademarks, and copyrights.

From nearby Arlington, Va., I got a letter from **Rick Hendrick**, extolling the virtues of his Com-

modore C64 system. Rick includes some geometric designs that were machine-drawn and, from his enthusiasm, I'd almost believe that Rick works for Commodore, but I don't think that is the case.

Finally, I had several conversations recently with **Jorge Rodriguez** who is already getting the ball rolling for the 35th reunion. As you recall, those who attended the 30th elected Jorge class president as a "reward" for his excellent planning and execution of our reunion in June, and Jorge believes that long-range planning will be the key to the success of reunion 35. Jorge, **Bill Blatchley** (35th reunion chairman), **Tim Hart**, and **Sue Schur** recently met for dinner to discuss the reunion and other class activities, particularly the use of the Endowment for Innovation in Education. The endowment, thanks to your generosity, now totals \$649,000. While the provost of the Institute will determine the endowment's specific use, they discussed possible uses with Diana Strange of the Alumni/ae Association. Diana will serve as liaison with the Institute, and I will keep you informed in this column.—**Frank A. Tapparo**, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

## 61

A sad note from **Alvin Dammig, Jr.** (Course 8) sister lets us know of his death back in December of 1986.

Here is a smattering of press clippings. . . . **John O'Connell** was named a Fellow of the American Institute of Chemical Engineers because of his expertise in thermodynamics. . . . **Richard Born** works for Varian in Palo Alto. He is VP and general manager of Varian's Microwave Power Tube Product Section. . . . **John Deutch** provost at MIT and is now an Institute professor. Dr. **Kenneth Macoul** is an eye surgeon in Haverhill, Mass. Last year he performed 450 cataract operations using lasers. . . . **Philip Kwok** is a "leading businessman" in Hong Kong and has organized a Liberal Democrats in the area. They advocate closer ties with China, despite the fact he is "worth more than \$100 million."—**Andrew Braun**, secretary, 464 Heath St., Chestnut Hill, MA 02167

## 62

### 30th Reunion

Whenever I see an article about advances in space travel, I look for the name of our classmate, **Robert R. Barthelemy**, director of the National Aero-Space Plane Joint Program at Wright-Patterson AFB. Sure enough, in the Sunday, March 10, 1991, business section of *The New York Times*, Bob described the ignition of fuel in the engine of the space plane: "To give you an analogy, it's a little like lighting a match in a hurricane." We can appreciate the problem, having been through a few major wind-storms, but we are also confident that Bob and his colleagues on the Space Plane Project will be able to solve it.

**Steven A. Orszag**, now at Princeton University, has been named the recipient of the 1991 Otto Laporte Award of The American Physical Society, Division of Fluid Dynamics. Steve will receive the award at the 44th Annual Meeting of the Division in November 1991. His citation reads: "For his many contributions to computational fluid dynamics, especially to the numerical investigation of nonlinear instability mechanisms in fluids, the onset of chaotic motions and the transition to turbulence; and for his contributions to the development of spectral methods of the solution for the Navier-Stokes equations." With the coming celebration of the 300th Anniversary of the Salem Witch Trials, we can truly appreciate the use of spectral evidence in scientific investigations even if it was finally considered inadmissible in the trials of the good citizens of Salem Village.

**Kenneth A. Rahn**, specialist in atmospheric chemistry, and professor of oceanography at the University of Rhode Island, writes that his son,

**Kenneth, Jr.**, has been appointed to the U.S. Military Academy at West Point to begin studies in 1991. Ken's daughter, Gail, will be visiting South Africa during March 1991, as part of the Youth-to-Youth exchange between countries. Classmates may recall that Ken lost his wife, Julie, in April 1989. . . . **Raymond P. Wenig** informs us that he has moved to the Cape to relax and enjoy creative efforts in addition to business activities. He has been authoring technical and managerial books on information systems. One of his recent efforts, a case workbook (*Computer Aided Software Engineering*) was published by Macmillan, and he has five technology overviews for QED Press. . . . You, too, can see your name in this very column! Drop me a line when you get the chance: **Hank McCarl**, secretary, P.O. Box 352, Birmingham, AL 35201-0352

## 63

**Dave Johnson** called me from Guilford, Conn., to apologize. Really, it wasn't his fault. You see, he's on the board of the American Field Service, and they did the wrong thing, but Dave did the right thing. Confused? Let me straighten you out. The board had recently to decide whether to move the organization to Chicago or Baltimore. Baltimore—the right choice (I know 'cause I live in metro Baltimore)—did a low-key, factual presentation. Chicago did a razzle-dazzle and came out the winner. Dave voted for Baltimore.

Dave is also in a New England organization called Murder Mystery Madness. They put on mystery dramas at country clubs, churches, restaurants, school fund raisers, etc. Although they start with some basic facts and clues that must be presented, 98 percent of each performance is improvised. I get the impression Dave enjoys this stuff far more than his head-hunting

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business, or AFS. Anyway, I enjoyed getting a phone call from him, and I'd like to hear from you. Or, send me an E-mail over CompuServe.

Ron Alpert sent some money to the 'Tute and put some notes on the flap. He's with Factory Mutual Insurance, and recently expanded his duties as manager of fire and explosion research. His older daughter is now applying to colleges, bringing back memories of arriving in Cambridge from upstate New York, some 31 years ago. Of course, it is memory time for all of us now, as our kids repeat the events of adulthood-college, first full-time job, first independent home, marriage, their own kids, etc. Stay in touch with your classmates, and share these wonderful experiences, by writing to this column!

I have a press release to share about **Bernard Beaudoin**. He was just promoted to senior vice-president and CFO of Kansas City Power and Light. He's been with KCPL since 1980, and is in charge of all financial and regulatory matters for the company.

Don't forget, send me your news and ruminations. Speaking of which, my son Gary will be away from Cambridge this summer. He will be in Germany working with a professor there who shares professional interests in language acquisition.—**Phil Marcus**, secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (301) 750-0184, CompuServe 72047.333

## 64

There are a few news clippings and Alumni/ae Fund notes in my file; however, I'm saving them till next issue in order to use the space for a somewhat longer than average, and very interesting, letter from **Jeff Michel**, writing from Dorlinbach in the Federal Republic of Germany. He writes: "As many know, I have been living in Germany's Black Forest since 1970, working as an electronics engineer, free-lance translator, and journalist. What I never mentioned previously is that a good deal of private attention has been devoted to the conditions of life in East Germany. Before the Berlin Wall fell, I had visited the GDR on extended visits more than 50 times, sharing human experiences with hundreds of people under hardly enviable but altogether compelling circumstances. In talks that generally lasted into the early hours of the morning, we were never able to determine a justification for the politics of confrontation based on different birthplaces.

"German national division prevailed as an opportunistic and illusionary device for insuring world peace, while individuals struggled against

the isolation it imposed. I calculated that the number of parcels the Germans were sending back and forth across the border each year were three times the total volume of CARE packages sent from the USA to Germany in the postwar period. That was evidence that human bonds continued to endure.

"I pursued this interesting situation by researching the special conditions of coexistence between East and West Germany. An article with some of my findings appeared in the spring 1987 issue *Studies in Comparative Communism*, published by the University of Southern California, entitled, 'Economic Exchanges Specific to the Two German States.' The concluding appraisal proved to be prophetic: The remarkable contributions of private individuals have demonstrated the continuing viability of German unity, on whatever political basis that may ultimately be confirmed."

"The opening of the border was embellished by the fact that November 9 is my birthday, which I had frequently celebrated in the GDR. On that evening in 1989, I happened to be driving to Berlin as the announcement of unrestricted travel was made. Approaching the border crossing point to West Berlin, a traffic jam a mile long had already formed on the transit highway. I had the sensation of floating over the Wall on the first tidal wave of freed East Germans. That was a birthday present hard to beat.

"I had driven to the city for a clandestine meeting with environmentalists in the East Sector, which upon the fall of the Wall was suddenly absolved from being conspirative. For years, I had been supplying information to East German ecological groups. The diligent activity of the secret police (Stasi) in shadowing me must have contributed some fascinating data to their collection on foreign agents.

"The transparency of environmental information in Eastern Europe has since made apparent the immense tasks of decontamination and modernization ahead. I have been giving lectures on problems and solutions in Germany, Czechoslovakia, and the USA, published articles for various magazines, written reports for broadcast on Deutschlandfunk radio in Cologne, and intensified my activities for a number of environmental organizations. Much of my recent research has been directed to analyzing the problem of air pollution in East Germany. I am extending my engineering consultation activity to decentralized energy concepts as one way of remedying the situation. The principal difficulty in all former socialist countries, their limited economic resources, lies with the inadequate competitive potential of local industries on the world market. How many Westerners have ever consciously used an East European product? That indicates how deficient international commercial participation has been."

I'm sure you all enjoyed reading Jeff's letter. The space is available to any and all classmates with information to share. Just send your news to **Joe Kasper**, secretary, RR2, Box 4, Norwich, VT 05055

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**Steve Lipner** writes that he is still recovering from a late July 1990 accident on the Appalachian Trail in Maine. Steve tripped and broke his left leg. After his companion hiked out 12 miles, they sent in a Marine National Guard medevac helicopter which Steve flagged down with a mirror. He was picked up with a sling and flown out. After initial good progress, he rebroke the leg slipping on "rotten lettuce" in the local supermarket. As of this writing (February) he is back down to one crutch and again on the road to recovery. By the time this is printed, we hope he'll be back to running!

**Rick Gander** has shifted from Arthur D. Little to Charles River Associates here in Boston after 18 years at ADL. Charles River is an economics

and management consulting firm with a widely recognized capability in the area of metals and minerals which are Rick's specialty.

Rick's older daughter, **Decky**, is at Duquesne continuing her violin studies after graduating from Amherst, and playing in five orchestras. His younger daughter is in high school in Newton. His wife, **Candy**, recently started her own architectural firm and is involved in the site search for the second Boston airport.

In September, he played in his second annual alumni-student baseball game (the alumni won). He encourages more people from the mid-60's to get involved in this exciting sport (after all, there are even some professional players our age out there—well, almost our age). If interested, call Rick (617-266-0500).

**Bill Pike**, **Richard Homonoff**, **Ken Cairns**, **Peter Heinemann**, **Joel Greenwald**, **Steve Lipner**, **Bill Podolsky**, **John Krause**, and **Eduardo Barragan** all were reported to have taken part in the "Bill Pike" '65 Walk Across the Harvard Bridge Without a Care in the World" at our reunion Sunday morning. Bill reports that despite the hot sultry day, their spirit was upbeat and they actually felt as though there wasn't a care in the world—a real trip across memory lane.

Bill recently left Fidelity Investments and is primarily spending time with his young family (Ben, 7, Leo, 5, and Terren, 1). While he isn't job hunting yet, if anyone has any good ideas for an experienced equity and junk bond investor he'd love to talk.

**Dick Ayers'** company, The Stanley Works, was recently featured in the winter 1990 issue of the *MIT Management Review*. For those of you who don't receive it, the cover showed a full page picture of Dick dressed in complete do-it-yourself gear. Turns out that he was actually standing on a self-built deck at his summer cottage and he really is into do-it-yourself!

Dick reports on the personal side that he has one child out of college, two in college, and two to go. He's calculated he'll have 25 years of college bills (and, if he's like us, he'll have graduate school in addition!)

Dick has become involved in more active recruiting at MIT, as Stanley emphasizes the technical/manufacturing side. He recently hired one of the first graduates of MIT's Leaders in Manufacturing program to work in line manufacturing at Stanley.

Dick currently is serving as the chair of Connecticut Business and Industry Association (7000 companies), Connecticut's largest business organization, and is secretary of the board of directors at the New Britain General Hospital and Conn Health Corp., the hospital's parent company.

Former Dean **Frederick G. Fassett, Jr.**, in honor of whom we made our 25th reunion gift, died January 7 in Maine. He was 89 years old. Dean Fassett joined the MIT humanities faculty in 1930, served in the Office of the Secretary of War during World War II, and returned to MIT in 1950 as the first dean of residence. He retired in 1967.—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

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Please send news for this column to: **Jeff Kenton**, secretary, 7 Hill Top Rd., Weston, MA 02193

## 67

### 25th Reunion

**John Fitz** is in his fourth year with the Combustion Engineering Nuclear Power Korea Project Management Team. He is responsible for managing the purchasing function for the project, which involves two pressurized water reactors, and is currently negotiating for two more plants to support Korea's rapidly growing electricity demand. Having merged with Asea Brown Boveri (ABB) a year ago, CE is now part of the largest

electrical engineering company in the world, and is poised to be able to meet all of the electrical utility industry's need for power producing technology. John's two children (ages 17 and 14) are both in private Christian schools. To meet present and future educational costs, John and his wife, Joan, are also engaged in a new business called "Melaleuca," marketing consumable products that use "oil of melaleuca" from Australia. Call John at (203) 653-4995 if you are interested in a solid income producing opportunity with INC. Magazine's 37th fastest growing private company (December 1990).

**D. Travis Engen** is executive VP for ITT Corp. in New York City. . . . Two years ago, **Jeff Schoenwald** was offered a six-weeks teaching consulting job in Beijing, where he would have had a front row seat at the uprising. Instead, he attended two conferences in Hawaii that were much more relaxing. . . . **Roy Gamse** is currently senior VP for services management at MCI Communications Corp., Washington, D.C. . . . **James Kirtley, Jr.** has been named a Fellow of the Institute of Electrical and Electronics Engineers. . . . **Kenneth Ogan** is principal scientist and senior product marketing manager at Hitachi Instruments.—**Jim Swanson**, secretary, 878 Hoffman Terr., Los Altos, CA 94024

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Greetings again from Washington. By the time you read this, we hope to be in Hawaii for the solar eclipse. Perhaps we will bump into some of you out there.

We hear from the Association for Computing and Information Processing that **Gerry Sussman** has received their 1990 Karl V. Karlstrom Outstanding Educator Award. He was cited for "significant pioneering work in introductory computer science education. Among his extensive contributions are two—The Scheme programming language and the text (coauthored with Harold Abelson), *Structure and Interpretation of Computer Programs*—that have helped educators reshape introductory courses." Gerry is a full professor in Course VI.

Also in academia is **Dan Green** who was promoted to professor of pediatrics at SUNY/Buffalo School of Medicine last summer. He is married and has three children: Daniel, 1, Sarah, 4, and Amy, 5. . . . **Gordon Logan** has two children, Carolyn Elizabeth, 2, and Gordon Edward, 5. . . . Farther afield, **Henry Brenner** spent two months recently in the Soviet Union as a Fulbright Scholar. . . . A recent column about APS fellows reminded **Ron Cohen** that he was so honored several years ago but hadn't written. Since then, he has "gotten remarried," to Isabel Berkelhammer and has a son, Joshua, 2. Ron is head of the Theory Program in Livermore's Magnetic Energy Fusion Division.

That's all for now; look forward to hearing from you. Have a good summer. **Gail and Mike Marcus**, co-secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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We're a bit thin on news this month, but now that you have come unglued from your front row seats watching the Gulf War on CNN, maybe you'll have time to write more. . . . **Peter Meschter** has joined the GE Research and Development Center in Schenectady, N.Y., as a materials scientist. From 1976-1981, Peter was an assistant and then associate professor at the University of Tennessee. From 1981-1990, he was a scientist and then senior scientist with McDonnell Douglas Co. in St. Louis, Mo. He and his wife, Mechthilde, have two children and live in Niskayuna, N.Y. . . . **Hans W. Polzer** writes that he is now director for the "STARS" Program at Unisys Defense Systems. Stars is a DOD program sponsored by DARPA to dramatically improve

software engineering on DOD systems. IBM and Boeing/DEC are two other prime contractors on the program, Hans notes.—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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**Lee Shaeffer** has moved from Unisys to become VP for marketing for Nantucket Corp., a software company based in Los Angeles that develops application development systems for the PC. A Course 6 major, Lee got an MBA in marketing and accounting from Stanford. Along the way, he has handled produce marketing for such companies as Convergent Technologies and Apple.

**Howard Morris** has been promoted from controller to CFO of Macomber Development Associates in Boston. . . . **Joel Lamstein** tells us that he has been elected to the board of The Children's Health Fund.

It is our sad duty to report that **Irene "Mac" du Pont III** has passed away.—**Greg and Karen Aronson**, co-secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

## 71

**Donald S. Raila**, OSB writes: Peace to you! I thank you for the invitation to our 20th reunion. Although I am a Benedictine monk here in Latrobe, Pa., and there is no way for me to be present physically, I shall be with you all in spirit and in prayer. May our reunion be a time of joy, gratitude, and renewed fellowship." . . . **Oljan Repic** was named associate director of chemical research and development at the Sandoz Research Institute in East Hanover, N.J. He is responsible for three functions: the prep labs, isotope labs, and process R&D, the common denominator of which is organic syntheses. He says he owes his fondness of and success in organic chemistry to Professor Kent (I love kempistry), who is able to explain it.

**Tom Crosby** became a certified photo finishing engineer after passing the CPFE exam of the Society of Photofinishing Engineers with a grade of 89 percent. He is currently working at the Dallas plant of QUALE Ex, Inc., which is the largest photofinishing corporation in the U.S., and perhaps the world. You can reach Tom at 1601 N. Irving Heights Dr., No. 105, Irving, TX 75061. . . . **Diane Feldman Eisenstat** married Barry Eisenstat, '69, in 1974. They have three children, Rachel (12), Jared (10), and Zachary (6). She has a PhD in physical chemistry ('78) and an MBA ('79) both from Columbia. After getting an MBA, she worked for Mobil until the summer of 1990 and is now in strategic planning at Reuters Information Services in their New York office.

**Cha-Mei Tang** has been elected a fellow of the American Physical Society. Tang is head of the radiation and acceleration physics section of the Beam Physics Branch in the Naval Research Laboratory's Plasma Physics Division. She was cited "for her pioneering work in the development of computer models and codes for understanding the physics of free electron lasers, quasioptical gyrotrons and laser plasma accelerators." She received BS, MS, and ScD degrees from MIT. She has authored over 60 refereed general publications and has contributed to more than 30 book chapters and conference proceedings. She and her husband, Bertram Hui, and their two daughters, Jamie (9) and Julie (1), live in Potomac, Md.

**A. Robert Sohval** has been appointed executive vice-president and general manager of Elscint, Inc., the U.S. subsidiary of Elscint, Ltd., a worldwide leader in medical imaging systems. He received a bachelor's degree and doctorate in physics from MIT and is a member of Phi Beta Kappa and Sigma Xi. He joined Elscint in 1979 as a research physicist. In 1984, he was transferred to Elscint's corporate R&D center in Haifa, Israel,

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where he directed the development of a new high-resolution CT scanner. He holds numerous patents in computed tomography and medical imaging.—**R. Hal Moorman**, secretary, Box 1808, Brenham, TX 77834

## 72 20th Reunion

**Ed Rich** has been promoted to treasurer of Dow Chemical Canada and is now living in Sarnia, Ontario, just across from Port Huron, Mich. This follows two years of living in Switzerland being treasurer of Dow Middle East/Africa/Eastern Europe, needless to say an interesting and challenging assignment. The family likes Canada a lot. . .

**Richard Braun** has moved his family to their 4th house in ten years, settling now in Yorktown Heights in Westchester County, New York. His wife, Eileen, is setting up a ceramics studio in their basement. Their 12-year-old is preparing for her bas mitzvah, and the 9-year-old daughter is busy having fun. They like their new friends but miss their friends in Chicago including Pi Lam's **Tom Wolfe**, **Dave Mark**, and **Lenny Davis**. Richard is now manager of new venture development, molecular sciences at the Tarrytown Research Center.

**Michael T. Errecart** is now in his 13th year at Mairo as vice-president. . . **Nicholas G. Lazaris** has left Wright Line, Inc., to become president and CEO of M.W. Carr.

That's it for this month's news. I write on a lovely spring day and wish you a great 4th of July, which is about when you will read this. Please send us more news of what you are doing to share with your classmates.—**Wendy Elaine Erb**, co-secretary, 6001 Pelican Bay Blvd., Apt. 1003, Naples, FL 33963

## 73

**Mike Ashmore**, who was formerly a principal at Index Systems in Cambridge, has stepped up to the post of vice-president with Temple, Barker, and Sloane in Lexington, Mass. Congratulations on your new slot, Mike. . . **John Chandler** is still busily testing gravitational theory "via analysis of solar system data" for the Smithsonian. The family has grown, but they're in the same house 12 years now. Last summer, during an extended vacation, he paid visits to classmates **Matt Wolfe** and **Larry Esposito**, our frequent correspondent.

We are fond of "frequent correspondents," folks, so please—write!—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

## 74

These are the days of miracle and wonder, says Paul Simon. Maybe he's right. . . your humble scribe received a long letter from **Chuck Rosenblatt** the other month, for which I am exceedingly grateful. Chuck says their four years in Cleveland have been quite pleasant. He's holding joint appointments in the Physics and Macromolecular Science Departments at Case Western Reserve University. Miriam, his wife, is a clinical data analyst and statistical programmer at University Hospitals. All their working hours, free time and then some, are spent entertaining Naomi and Danny. "The only drawback to living in Ohio is that we're 500 miles from the ocean and good salt-water fishing!"

Chuck also writes with news from **Albert Lazarini** who is working on optical sensors as part of a project for NASA and living in Colorado Springs with wife Martha and four children. . . News from the Heartland. **David Withee** writes with the ambitious tone of a man who sees what he wants and knows how to get it. He was recently promoted to product group manager, the first non-family member to reach that level in his

family-owned company. "It's currently the weakest of the four product groups but won't be when I'm finished." Dave and Mary are waiting patiently to hear when they have a child to adopt. He recently saw fellow classmates and ATO brothers **Jia Shu**, **Scott Schlechter**, and **Greg Burnett**. All are doing well.

**Bruce Schreiber** called to give me the news of his wife's passing in January. Bruce and Tina were high school sweethearts, and she had many friends and acquaintances throughout MIT. Bruce and the boys, David and Jonathan, are "okay, now." . . . An obituary from the *Boston Globe* in late January informed me of **Larry Goldstein's** passing. Larry lived in Belmont and we were casual acquaintances, both being in the software business. I guess it's never too early to get comfortable with the reality of your own limited time.

**Jean and Paul Moroney** announce the birth of their third child, born in October 1990. Eric Paul joins Elizabeth and David, already on the team. Paul is working for General Instrument's Videocipher Division. . . **Neil Cohen** writes, "The American Law Institute recently named me Reporter (principal author) of the Restatement of the Law of Suretyship." Neil is a professor at Brooklyn Law School where he teaches courses in commercial, corporate, and constitutional law. . . Tired of that desk-bound job? How about being director of technical operations and engineering for a luxury passenger ship line? **Charalabos Psimarnos** has ascended to that position with Premier Cruise Lines in Florida.

We end this month with a warning about the dangers of excess from **Rodney Hartman**. Classmates don't let this happen to you! "Have started golfing with wife Becky this past year and, in November, moved to the golf course." Rodney is still head of the Radiology Department at a local hospital, so he's learned to live with his addiction. An inspiring story of courage! . . . Hope your summer's a hummer.—**Lionel Goulet**, secretary, 115 Albemarle Rd., Waltham, MA 02154-8133, (617) 899-9694

## 75

Just a couple of items this time. **Richard S. Withers** writes: "I continue to work as associate group leader of the Analog Device Technology Group at Lincoln Lab. I also coordinate efforts to apply superconductivity to microwave and high-speed interconnect systems here and at IBM, Bell Labs, MIT campus, BU, and Cornell, as a technical program manager within the Consortium for Superconducting Electronics." Without going into the details, Richard also indicated his marital status has changed—he is once again single. . . **Jeffrey L. Star** informs us that his daughter had her second birthday, commenting, "Parenting is a ton of fun, most of the time." Also, Jeff's textbook (*Geographic Information Systems—An Introduction*, Prentice Hall) is entering its third printing, and there are plans for a 1992 second edition.

I received a nice note from **Beverly Herbert**, who said she plans to teach a couple of courses during the next academic year at a local seminary. She enclosed the following write-up from the February 1991 issue of *Black Enterprise*. . . "Gerald F. Adolph is the epitome of a fast-tracker of the 1980s. Armed with a master's degree in chemical engineering from MIT and an MBA from Harvard, the 37-year old VP and partner at Booz Allen & Hamilton, Inc., troubleshoots for corporations in many areas. Adolph started as a chemical engineer for the Polaroid Co. right out of MIT. He was recruited by Booz Allen from Harvard in 1981 as an associate and two years later was promoted to senior associate. In 1985, he became a principal at the firm and was elected partner three years later. Adolph, who makes more than \$200,000 a year, says the best part of working for Booz Allen in participating in senior management decisions. The downside is the long hours, constant travel, and the unpredictability of the business world. Booz Allen, the world's lar-

gest general management consulting firm, specializes in strategic planning, operations, mergers, and acquisitions."

That's it for this time. Keep writing.—**Jennifer Gordon**, secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036

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Please send news for this column to: **Arthur J. Carp**, secretary, Voice Recognition Technologies, Inc., 220 Henley Rd., Woodmere, NY 11598; (516) 295-3632, fax (516) 295-3632

## 77

### 15th Reunion

**Daniel R. Higgins** has been initiated into the Fellowship of the American College of Surgeons. Daniel received a medical degree from Penn and currently specializes in general and vascular surgery. He practices in Palm Beach, Fla. . . **Simeon Chow** is now an assistant professor of marketing at Boston University. Simeon received a PhD from Sloan School in 1987; his specialty is advertising research. . . **Werner Haag** reports that he finds raising twin two-year-old girls a lesson in patience, but "twice the fun." . . **Mitchell Kling** and his wife, Carol Acton, were expecting their second child in April. They live in Maryland, where Mitchell heads a depression research program in the Clinical Neuroendocrinology Branch of NIMH in Bethesda. He hopes to become tenured in a year or two. . . **Michael Di Novi**, and his wife, Beth Barnett, are expecting their first child in October of this year. . . Sorry for the short column, but as usual, I don't MAKE UP the news, I just report it as I receive it. Hope you all have a fine summer. Please write to me describing all of your exploits.—**Ninamarie Maragioglio**, secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153-2522

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While gazing out his office window onto the Charles River, **Art Lewbel** called your secretary to talk about what he's been up to for the past 13 (!) years. After getting a bachelor's in math, Art worked for Data Resources, Inc., for two years. He returned to MIT and received a PhD from Sloan in 1984 and is now a tenured associate professor of economics at Brandeis. For the past two years, Art has been a visiting professor at Sloan, teaching econometric theory to master's students. He has been really enjoying his time at the Tute. Art married Laura Dickerson in 1980, and they have a 3-year-old daughter, Florence. Art was one of the founders of the MIT Juggling Club when he was an undergrad, and he has been involved in the club since then. The Lewbels are living in Lexington, Mass.

A brief postcard from Susan and **Rich Perlstein** arrived to report the move to their house in Corte Madera, Calif. . . **Eugenia Parnassa-Carroll** writes that she has two sons, Ian Andrew Carroll (2) and Nicholas Black Carroll (1). Eugenia and family are living in Chicago, where she is a cardiologist. . . **Sue Kayton** writes, "I'm working at a new job—toy prototyping. It's a lot more fun than satellites, and my kids can help test the finished products." Sue and family are living in Los Angeles. . . **Dave Medeiros** has joined Charles River Associates (CRA) in Boston as a senior associate in technology assessment. Before joining CRA, Dave worked for Digital Equipment as a marketing consultant. Prior to that, he held marketing and engineering positions at Wang Labs, Draper Labs, and Stone & Webster. Dave received a master's degree from Sloan in 1983.

Your class secretary and wife, **Diane Curtis**, adopted a beautiful baby girl, Danielle Renee Bidigare-Curtis, in early March. She was born on February 27. We are incredibly happy to have her with us, and we are gradually adjusting to the

changes that she brings to our lives.—**Jim Bidigare**, secretary, 322 Central Ave., Newark, OH 43055, (614) 345-8582; **Julie Kocacka Stahlhut**, assistant secretary for Networks, Internet: jstahlhu@hstbme.mit.edu; Compuserve:76566,1012

## 79

In January of last year, **Carroll J. Yung** became a partner in the Washington, D.C., law firm of Fisher, Wayland, Cooper & Leader, where he concentrates in the area of communications law. Carroll received a law degree from Cornell in 1982. . . . More good news: **Jonathan Keefe** and his wife, Johanna, had their first baby, Elsa Marie, last October 9. . . . **Fort Felker** and his wife, Robin, are expecting their second child. (To quote Jonathan, "Baby Booms, The Sequel.") . . . **Wesley Harper** is a member of the class of 1992 at Northwestern University's J.L. Kellogg Graduate School of Management. He was previously a senior associate with Barton Aschman Associates. . . . Your faithful secretary is busy rehearsing the lead in the musical *She Loves Me*. My Off-Off-Broadway theatre group has relocated to a new space a few blocks away, even further away from Broadway than before! Having a blast nevertheless—**Sharon Lowenheim**, secretary, 98-30 67 Avenue, Apt. 6E, Forest Hills, New York, NY 11374

## 80

**Chris Moss** and his wife Mira (Wellesley '81) have moved to Atlanta, where Chris took a promotion with Anderson Consulting. Mira finished a PhD in psychology and is looking for a consulting position. . . . **Constance West** is also on the move. She is finishing a fellowship in pediatric ophthalmology at Johns Hopkins. After a three-month summer vacation she plans to start a job in Portland, Maine, or Pittsburgh. . . . **Jeff Crothers** will be making a move across the Atlantic. Davidson Instrument Panel/Textron has announced his promotion to engineering manager in Europe. He will be living in the Netherlands. . . . **Charles Lurio** is now a senior systems scientist at the Advanced Systems Group at Aerodyne Research, Inc., in Billerica, Mass. He will be working on aircraft infrared signature analysis and developing proposals for research under the NASA Space Exploration Initiative. . . . That's all the news this month. Please write or call me directly with your news.—**Kim Zaugg**, secretary, 2384 Leslie Circle, Ann Arbor, MI 48105, (313) 665-2365, vayda@drs4330b.erin.org.

## 81

Hello everybody. Hope you all had a great time at our 10th Reunion!

**Tom Semple** writes to say that he was married last November 17 in Galveston, Tex. Tom's lovely wife is Antoinette Gambini. **Kevin Bowie** served as best man, and three other MIT alums were present: Mark Johnston, '84, Andy Stevens, '86 and Terry Thompson, '82. The newlyweds reside in Houston. Congratulations. . . . **Marjorie Madson** is "hanging out in Manhattan and building up her Statue of Liberty Collection." Her activities include designing pins, folk art, and painting. Her day job is compensation consulting. . . . **Lori Ullman-Herman**, MD, is an assistant professor of medicine in the Division of Dermatology, at University of Massachusetts. She also maintains a private practice in Providence, R.I. In her spare time, she sings, paints, and acts.

**Laurie Christopher** is with Thomson Consumer Electronics in Indianapolis, where they make RCA TVs. Laurie is the manager of the advanced TV group working on high density TV. She's enjoying Indianapolis especially since she became engaged. Details at the reunion! . . . **Howard Marson** was recently promoted to senior market-

ing manager at Phoenix Technologies Ltd., a PC software company in Norwood, Mass. . . . **Joan Horvath** is still with JPL in Pasadena, where she recently moved from the Magellan project to the Topex project. Joan was named a AIAA distinguished speaker last year.

**Joy Weiss** is the director of marketing for the Pacific region office of Northern Telecom. She enjoys living in Oakland, Calif. . . . **Howard Blakeslee** writes that he is currently with the U.S. Air Force working at Edwards Air Force Base, in California on combat and gunship programs as an electronic warfare officer. He is also flying F-4s on the side and hopes to be moving up to the F-15E strike eagle soon. Howard has been married to Gail Standish, '85, since 1984. They have two huskies. . . . Also in the Air Force is **Deborah Galaska**. She recently finished an MHS in Environmental Health Engineering at Johns Hopkins University and currently is a consultant at Armstrong Laboratory in Okinawa, Japan. Deborah and her husband, Pat, are both captains. Deborah says that they are busy with their six beautiful children, ages 2 to 14. . . . Also in Japan is **David Copeland**. Dave is a visiting researcher at Hitachi Mechanical Engineering Research Lab in Tsuchiura, which is about an hour from Tokyo. Dave reports that the skiing is somewhat better than New England and the taxes are lower. He is also enjoying his break from six years at IBM.

Finally, as a result of the Alumni/ae Fund class agent program, I have had the opportunity to speak with a number of classmates, many of whom I hadn't kept in touch with since graduation. I called **Gail Cooper Koretz's** home in Los Angeles to learn that she had just arrived home from the hospital with daughter, Rachel Elizabeth. Congratulations to Gail and her husband, Paul. The Koretzs have been married since 1985. Gail is an attorney. . . . USAF Captain **Stephen Fairbairn** will be moving to Edwards Air Force Base, where he will test pilot some of the military's latest flying machines.

**Diane Lebowitz** is living in New York City and working long hours at Lehman Brothers in options trading. . . . **Andy Meade** is working in New York City for Toda, a large Japanese construction company. Andy, his wife Karen, son Tyler, 2, and daughter Rianna, 1, live in Chappaqua. . . . **Nora Fong** is living in Davis, Calif., where she is attending law school. Nora may be our class' only JD/MD.

That's it for now.—**Lynn Radlauer Lubell**, secretary, 2380 Northwest 41st St., Boca Raton, FL 33431

## 82

### 10th Reunion

I am personally saddened to announce the sudden death of our classmate, **Theodore E. Baker**, on December 15, 1990. After graduation, Ted received both a master's and PhD from UC/Berkeley and worked at Barra Corp. developing models for the predictive behavior of financial instruments. His father writes that Ted's death was caused by heart failure stemming from a congenital heart defect and that Ted "lived every moment to the fullest, perhaps feeling that his days would be limited."

Kudos for best letter of this mailbag go to **Michael Post** for his poem about marrying his wife, Anne. Here's an excerpt: "Now we're together and doing fine/And her two children I now call mine/With all these kids, and two cats too/Plus four hamsters, it's a veritable zoo! . . . **Bruce Entwistle** is also getting married, to Laura Smith, and getting an instant family of three daughters ages 7, 9, and 11. After working for Proctor & Gamble in Cincinnati since graduation, Bruce transferred to the P&G plant in Quincy, Mass., last year. . . . **Rich Auchus** married Mary Lou Campbell (Wellesley '84) last November, attended by **Mike Petti** and his wife, **Toby (Schafer) Petti**. Rich and his wife are completing internal medicine residencies at the University of

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Iowa and will be doing their fellowship training at Wilford Hall USAF Medical Center in San Antonio, Rich in endocrinology/metabolism and Mary Lou in hematology/oncology.

**Baby update:** **Dexter Charles** and his wife, Lisa, had their first child last November, a baby boy named Dylan Hollingsworth. . . . **Linda Hoffman** and her husband, Charles, '80, had their third child in January. Catherine Anna has two older brothers, Richard (5) and Alexander (3). . . . **Steven Brunner** and his wife, Patricia Ochs, who were married in 1988 and had a baby daughter, Anna Elizabeth, in August 1990. . . . **David Delfs** reports that the birth of their first child, Brian, to he and his wife, Ann, in 1989 spurred him to finish a PhD in computer science at Carnegie Mellon—over a year later. David is working for DEC's Systems Research Center in Palo Alto, Calif. . . . **Brian Jay Glass** is the father of James, born last November, and is working at NASA-Ames.

**More babies:** Elizabeth and **Martin Carrera's** son, William Martin, was born in January 1990. . . . **Gerald Fitzgerald's** son, Trevor John, was born last July. Gerald is assistant director of application development at Smith Kline Beecham. . . . **James Dempsey** and **Heidi Picher Dempsey** had their first child, Samantha, last October. Both James and Heidi work at BBN in Cambridge on computer networks. . . . **Eric Fujii** and his wife, Cheryl (Wellesley '81), are the proud parents of Jared. . . . Babies that should have come by now: **Cynthia Ann Hale Nicholson** was expecting her first child in March; she is working for General Dynamics Land Systems in the Main Battle Tank Program Office. . . . **Richard Soley** and his wife were expecting a younger sibling for 2-year-old Alexander around April Fool's Day. Richard is VP/technical director of Object Management Group, Inc., a software industry consortium.

**Awards and promotions:** **Thomas Warren**, a consultant for Arthur D. Little, was a co-winner of the American Society for Testing and Materials' Sam Tour Award for a 1989 paper on corrosion. . . . **Vincent Rojo** received two Lockheed Sanders book awards for articles he had written on radar systems. . . . **Dennis Martinez** was promoted to VP of advanced technology at M/A-Com/Adams-Russell Communication Technologies Center and is a part-time faculty member at Northeastern University.

**Getting educated:** **Matthew Prete** has gotten an MBA from the Sloan School. . . . **Jeffrey Lee** received a PhD in microbiology from N.C. State University in 1989 and is now a research associate there. . . . **Glenn Cassidy** completed a PhD in public policy analysis at Carnegie Mellon last July and is an assistant professor in the Department of City and Regional Planning at the University of North Carolina, Chapel Hill. . . . **David Shapiro** is hoping to complete a PhD in statistics at Stanford this summer. . . . **David Kieda** has been promoted to assistant professor of physics at the University of Utah. . . . Apologies to **Keith Sawyer** for reporting that he was studying physical anthropology at the University of Chicago when he's really studying psychological anthropology.

**Musicians among us:** **Suzanne Hirschman** plays with a medieval band and is doing thesis research on digital wave guide simulations of reed instruments for an electrical engineering degree at the Stanford Center for Computer Research in music and acoustics. . . . **Richard Cohen** now works for the Young Chang R&D Institute, run by a Korean piano manufacturer who bought the assets of Kurzweil Music Systems, where Richard used to work. . . . **John "Pat" Kinney** continues to be an active amateur clarinetist at MIT and around Boston. Professionally, he has been involved with the Society of Actuaries' Education and Examination Committee and serves on a committee and a task force of the Actuarial Standards Board.

**Physicians among us:** **Daniel Chernoff** is doing a radiology residency at Brigham and Women's Hospital in Boston, having finally gotten an MD

and PhD from the HST program last June. . . . **Howard Haber** is a fellow in cardiology at the University of Virginia in Charlottesville. . . . **Dudley Hall** was recently featured in an article in his hometown newspaper about how four of the five children in his family have become physicians. Dudley attended medical school at Tufts University and did his residency at St. Mary's in Waterbury, Conn.

**Navy Lt. David Wilson** was deployed to the Middle East on the carrier U.S.S. *Independence* last fall as part of Operation Desert Shield; he has been in the Navy since graduation. . . . **Peter Rogers** is a launch controller in the Air Force Space Command's First Space Launch Squadron at Cape Canaveral Air Force Station. He completed an MS in engineering management from the Florida Institute of Technology. . . . **Bryan Fortson** was assigned to the Air Force's Phillips Laboratories in New Mexico after finishing a PhD in aerospace engineering at Georgia Tech last September. . . . **Gerard Weatherby** writes that he left the Navy submarine force (two months before the Iraqi invasion of Kuwait) and is teaching high school math and science in New Britain, Conn. While raising a 3-year-old daughter, Gerard still finds time for photography and is "slowly writing some fiction stuff that could end up being a book."

**Daniel Grunberg**, **Doug Chin**, and **John Iler** have started a company called Jackson Hewitt Systems Corp., specializing in rewriting obsolete software for new operating systems and equipment. Daniel and his wife, Elaine, have two children. After finishing a PhD in 1987, **John Lucassen** spent a year in Japan working for IBM, then worked as a management consultant for McKinsey & Co. in Amsterdam and then New York. John currently works for IBM's research division in Hawthorne, N.Y. . . . **Timm Anderson, Jr.** is now working for Aerodyne Research's Advanced Systems Group in Billerica, Mass., as a senior software developer.

**Jason Kaldis** is working for a small residential architectural firm in Berkeley and serving as associate director of the East Day Chapter of the AIA. Jason is also volunteering to teach about residential design and architecture in a local high school. . . . **Lori Alperin Resnick** is an AI researcher in knowledge representation at Bell Labs in Murray Hill, N.J. . . . **Joel Gendler** is a science editor at D.C. Heath textbooks. . . . **Brian Leibowitz** is the proud author of a book on the history of hacking at MIT (published by the MIT Museum). After two years of struggling on the book, he is trying to finish his thesis and get a PhD in materials science and engineering at the Tufts.

There's even news from all three class secretaries this month. **Michelle Gabriel** is now in the MBA program at UC/Berkeley, class of 1992. . . . **Linda Schaffir** is engaged to Michael Sigman and will be getting married in October. . . . **Kenneth Snow** and I have just bought our first house, so make sure your next letter goes to our new address in Newton, Mass., or to East Coast correspondent **Linda Schaffir** (50 Aiken St., No. 512, Norwalk, CT 06851) or West Coast correspondent **Michelle Gabriel** (656 S. Fair Oaks Ave., D 211, Sunnyvale, CA 44006).—**Stephanie Pollack**, secretary, 25 Royce Rd., Newton, MA 02159

## 83

I am pleased to announce a new record for unsolicited mail from our class: three letters. . . . **Earl Bartley III**, a first-time writer, went to Penn medical school and is now in his residency in orthopedic surgery at Northwestern Memorial Hospital in Chicago. Next year he will be doing a fellowship in total-joint arthroplasty at the University of Western Ontario in Canada. Earl has been married for over three years to Trudy Preston (Wellesley, '81) and they have two fraternal twin boys, Chris and Tyler, born April 15,

1990. Earl also notes that he recently joined Army Reserves Medical Corp., and was sweating out the Gulf War (which, thankfully, just ended).

**Dave Rosenblitt** sent a postcard entitled "Un-matched Caribbean Beauty," the details of which I will leave to your imagination. Dave finally finished his PhD in computer science at MIT and was celebrating in the Caribbean. Dave will start working at start-up WEB Development Corp. in Kennett Aquano, Pa., in February 1991. . . . **Ken Meltner** and Janice M. Eisen wrote to announce the birth of their son, William Gregory Meltner, on February 15, 1991. William was born in Schenectady, N.Y., and weighed in at 7 pounds, 3 ounces.

I recently attended the nuptial vows of **Kristin (Kinta) Foss** and Paulmer Soderberg in Livermore, Calif. The lovely wedding was held in a winery (the particle accelerator was booked) and was attended by **Mike Santullo**, **Alan Taylor**, **Chris Schnieder**, Laurie Barrett, '85, and Mark Farley, '84. Kinta, who once again has proven that the position of IFC treasurer is a stepping stone to future greatness, has been climbing the ranks at Raynet, a telecommunications company.

Speaking of weddings, as I am typing this, **Hyun-A Park** called and announced her engagement to Jacob Friis (Sloan, '90). Hyun-A is busy organizing an entrepreneurship conference at MIT and working on the Central Artery Project. Jacob works for Symmetrix in Burlington. Hyun-A also reports that **Matt Haggerty** was recently a finalist for the *Inc.* magazine's Entrepreneur of the Year award. Matt's company, Product Genesis, specializes in engineering design and product development.

The following people wrote in while giving money to MIT: **Doug Pennock** moved to Pennsylvania in late June 1990 to work for General Electric. His wife Cora gave birth to their first child, Rebecca Ann (class of '11), on August 13. . . . **Norman Hunt** was promoted to general manager of Sonex Corporation in Philadelphia. . . . **Don Clayton** is still working for Ingram Book Co. and is a recent daddy. His son Matthew was born in February. . . . **Richard Schooler** married (finally) his longtime companion Chantal Eide, and moved into a new home in Cambridge. Richard works for HP/Apollo in their excellent compiler group. He says he still sees Senior House classmates **Charlie Billings**, **Peter Fasse**, and **Bill Ijams**.

**Joe Grant** graduated in 1986 with an MBA in management and marketing from the University of Texas at Austin. He worked in computer systems consulting with Anderson Consulting, then with Edward D. Jones & Co. He is now working in product development at Credit Systems, Inc., a bank-card processor in St. Louis. Joe is engaged to be married to Ana Maria Gutierrez at the Old Cathedral in St. Louis on April 13, 1991. He wishes the best to all his Desmond (New House) friends.

**Robert Kidd** is enjoying life in the college of Ann Arbor with his wife Bonnie and cats Falstaff and Wolfgang (obviously didn't want to use up potential names for his kids). Robert works for Unisys Corp. researching image processing algorithms and architectures. Bonnie is completing a master's in voice performance at the University of Michigan. . . . **Kim P. N. Clinton** moved back to Vermont in July 1990. She started to work for IBM again in September after a year of maternity leave. Work is going well. She has a boy named Timothy, 2, and a girl Michelle, 10. Her husband Michael will be receiving a master's in electrical engineering this year.

And finally for the next installment in **Layton Montgomery's** forthcoming book *Life After MIT*. Layton writes: "After 7 years in and around the Peace Corps, I am finally back in the U.S. for the indefinite future. I stayed relatively healthy during my last seven months in Nepal—I only became deathly ill twice, although I was burdened with two months of extreme fatigue from unknown causes! It was interesting watching the government change from a system banning all

political parties to a multi-party democracy in Nepal after the Movement for the Restoration of Democracy of early 1990. . . . I only did two one-month trainings during my ten months as a teacher trainer, but I did find enough other smaller projects to keep myself busy." Layton hopes to start a doctoral program in September, subject to be determined by funding. He would like to study educational policy, focusing on the developing world.

Thanks to everyone who wrote in. Judging from the response, MIT's fundraising must be going well!—**Jonathan Goldstein**, secretary, TA Associates, 45 Milk St., Boston, MA 02109

## 84

**Sheena Murphy** wants to update all her friends thrown far and wide about her comings and goings. She finished a PhD in low-temperature physics at Cornell in October and promptly took off to Nepal for a month for a trip that included trekking in the Annapurnas. She returned to the United States as a postdoc at IBM Watson Research in Yorktown Heights. . . . **Dale Rothman** is a PhD candidate in resource economics at Cornell. He has been kayaking, biking, making ice cream, and hanging out with Niko (his parakeet).

**Larry Deschaine** was promoted to manager of the remediation services group at TRC Environmental Consultants. He is also pursuing a PhD part-time (huh?) at the University of Connecticut, focusing on economic optimization of remediation strategies. . . . **David Gerber** is flying F-15s at Langley AFB in Yorktown, Va. His son Christopher was born in November. . . . **Greg Brandeau** is half-way through his first year at the Fuqua School of Business.

**Richard Foster** is enrolled at Northwestern's Kellogg Graduate School of Management. Previously he worked at the Harrison Radiator Division of GM as a mechanical engineer. . . . **Peter Schunemann** has been prolific working at Lockheed Sanders marking his 10th published article (and associated LS book awards).

Finally, **Charlie Marge** sent some e-mail (this one is easy): "Guess who just got married? Me! Also **Kirk Mousley**. Kirk, who is working for Leeds & Northrup and pursuing a PhD in computer science at Lehigh, got married in May to Tracey Stempel in their hometown of Lansdale, Pa. **Rob Horwitz** and I were two of the groomsmen. **Bob Pearsall** was also in attendance.

"Two weeks later, I got married to Arlene Lanciani, '88. Rob (Horwitz), who is working for Microsoft in Seattle, flew East again for my wedding! Kirk and Tracey postponed their honeymoon in Hawaii for two weeks just to be at our wedding! Other Bakerites in attendance were Deacon Seraphim (Jeff) Solof, '81, who served in the wedding, Barry Mirer, '81, **Tony Riccobono** who flew in from LAX, and Dr. **Michelle (Heng)** and Randy Schweickart, '83, who were en route to Houston where Michelle is now doing her residency. Many people from the MIT Concert Band were in attendance as well, including the director, John Corley, the other assistant conductor, Ed Ajhar, '86, and **Michelle (Bagdis) Keller**.

"Arlene and I spent the month of June in Greece, which is an ideal place for a honeymoon. The water is true blue, the air is clean, it never rains, and the people know how to relax. We now live in Davis Sq. I'm still a consultant with Arthur D. Little where I work with **David Hermann** who is a contract programmer. I also run into **Steve Carroll** in the cafeteria. Also, I am still an assistant conductor of the MIT Concert Band. Arlene is finishing up a master's at MIT in building technology."

Oops, last but not least, **Eric Alani** became engaged to Esther "Es" Racoons. Eric is the final member of the infamous 346 quad to get married. It is interesting to note that our marriage order is reverse than that of our attaining PhDs. That is all for now. A business trip precludes me from

reporting on the Santa Cruz New Years Party which I will put off, again, until next month. For those interested in statistics the party garnered (an adjusted) 172,000 total round-trip miles by those attending.—From Bedrock, **Howard Rubenstein**, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213, hbr@mitre.org.

## 85

Now that the war is over, we can turn to domestic issues. On the home front **Janice Eisen** and **Ken Meltner**, '83, are delighted to announce the birth of their son, William Gregory Meltner, on February 15, 1991. . . . Also **Karen (Aichard) Armstrong** writes to share her good news with old friends. On December 22, 1990, she married Charles Armstrong, a colleague at the Johnson Space Center in Houston. She and her husband do planning, crew training, and flight control for the Space Shuttle and Space Station extra-vehicular activity. They spent their honeymoon skiing in Colorado and bought a cabin in the mountains to ensure their return for more vacations.

**John Landshof** is glad to be back on the East Coast after five years with McDonnell Douglas Space Systems in California. He is now working for Johns Hopkins University Applied Physics Laboratory in Baltimore. Frequently traveling on business, he says that he has dinner with MIT friends on an almost monthly basis. . . . **Lennart Moller** is now in his second year of medical school at University of California at San Francisco. Besides school, he volunteers for a free medical clinic and is having a great time living in beautiful San Francisco. While finishing his pre-med courses at S.F. State, he worked as an AIDS researcher, science tutor, and bartender. Prior to that he worked as a construction manager in San Francisco and Boston. He has also been doing a lot of traveling, including an eight-week backpacking trip in Europe before starting med school.

**Julie Forman-Kay** was awarded a PhD from the Department of Molecular Biophysics and Biochemistry at Yale University. She is currently doing post-doctoral work at the National Institutes of Health in Bethesda, Md. . . . **Jeff Chang** is still working at JPL, scuba diving, and studying Japanese. . . . **Charles Kwon** is now a member of the Class of 1992 at the J. L. Kellogg Graduate School of Management at Northwestern University. Formerly Charles worked at Booz, Allen, and Hamilton, Inc. . . . **Kenneth Eng** left Wang Labs after 4.5 years in the Large Systems CPU development group. He is now working in Waltham, Mass., as a digital hardware designer for Lexicon, a maker of professional digital audio products for the recording and broadcast industry.

**Bill Messner**, secretary, is (remarkably) still living in the same place. Send news to him at 520 Key Blvd., Richmond, CA 94805, (415) 237-3795; internet: messner%cmld56@ucbarpa.berkeley.edu.

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By the time this is printed, our reunion will have come and gone. Hope it is (was) a good time. **Sara Woodhull** has worked at Oracle for two years now, with lots of other MITers (Bob Broderen, '88 and **Al Chang**, to name a couple). She, along with her husband Craig Fuget, '83, is still very active in backstage work in Stanford Gilbert & Sullivan theater troupe (set crew, stage management). . . . **Andy Shooman** is working at the IBM's T.J. Watson Research Center in Hawthorne, N.Y., on network design tools. This just happens to coincide with his PhD thesis on network reliability analysis in the Computer Science Department of Polytechnic University in Brooklyn, N.Y. . . . **Kevin Talley** was recently promoted to captain in the U.S. Air Force. After he's spent four years flying satellites in Colorado Springs,

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W.S. Zolno, '54  
J.D. Guertin, Jr., '67  
R.M. Simon, '72

M.J. Barvenik, '76  
M.D. Bucknam, '81  
R.F. Cahaly, '80  
N.A. Campagna, '87  
F.W. Clark, '79  
R.E. Doherty, '87  
S.E. Gately, '85  
W.E. Hodge, '77  
W.E. Jaworski, '73  
C.A. Lindberg, '78  
J.D. Okun, '75  
K.J. O'Reilly, '80  
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Steven J. Henry, '73  
Theresa A. Hendricks  
Edward R. Gates  
William R. McClellan  
Peter J. Manus

Phillip G. Koenig  
Ronald J. Kransdorf  
Mark A. Fischer  
James J. Foster, '67  
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Colo., he's now getting a master's at the Air Force Institute of Technology. Kevin got married March 16, 1991, to Clea Madison.

**Doug Roth** is now an intern in surgery at NYU Medical Center and Bellevue Hospital as part of the five-year general surgery training program. He graduated NYU School of Medicine in May 1990. Doug says he'd still rather be sailing on the Charles. . . . **Ed Curran** has been living in South Bend, Ind., since his return from Belgium in May 1990. He is still working for Solvay, making fuel tanks out of plastic for the Big Three. Ed got engaged at Easter (1990) to Nora Walker, a fellow Solvay employee. They plan to marry sometime this year in San Antonio. Ed ran into **Julie Chen** at a rope conference in Washington last July. I hear Julie is still at MIT and still playing softball.

**George Georges** graduated in June 1990 from UC/San Francisco Medical School and moved to Dallas, Tex. He is now in the middle of his internship in internal medicine at the University of Texas, Southwestern. George plans to complete his residency there as well in the same field. Although the hours are ridiculously long and sleep nonexistent, George enjoys what he does. **Timothy Lee** is also there in the same internship program. . . . **David Simson** was married in August 1990 to Louise Lingaas in San Mateo, Calif. **Tim Shepard**, **Scott Berkenblitt**, and **Bob Baldwin** were among the guests. David is another MIT grad working for Oracle in Redwood Shores, Calif. When he's not working or looking for a house to buy, David volunteers on a Sheriff's Department Cliff and Dive Rescue Squad.

**Steven Kraft** will be graduating from University of Illinois Medical School in June 1991 and will then begin a residency in Pathology. . . . **Paul Moschetti** is still on Central Park So. (over four years!) He moved to Bear Stearns from Salomon Brothers two years ago and is now a VP at Bear. He's recording music with Felix Partow, '87; they recorded a promo tune for Absolut Vodka; his apartment is overflowing with equipment. **Stephen Offsey** is finishing up at Cornell. He received an MBA from the Johnson Grad School of Management at Cornell in December 1990. He hopes to finish a PhD in electrical engineering by May 1991. Meanwhile, he's looking for a job. . . . **Ed Kriegsmann** formerly an associate with Finnegan, Henderson, Farabow, Garrett & Dunner, is now a partner with Kriegsmann & Kriegsmann.

Finally heard from **Noel Zamot**. As of January 1991, Noel was flying pretty often during Desert Storm. "The enormity of the nothingness is overwhelming. Thousands of miles of . . . sand." He says they fly rather low and scare the occasional camel. Noel hopes to move on to B-1s and end up at flight test school. "I miss snow!" . . . Yale doctoral candidate **Alfred Rizzi** is working on the creation of a robot that can juggle. . . . **Brian Latt** is still working for Special Effects, Unlimited in Los Angeles, Calif. . . . **Roy Vandermolen** is currently living in Oak Ridge, Tenn., and working at the Oak Ridge National Lab. He's been there since leaving the Ampex Corp. in mid 1987. In addition to being an engineer at ORNL, Roy is an officer in the Coast Guard Reserve, an adjunct instructor at a nearby community college, and an adjunct instructor at a tech school in Knoxville. He and his wife (and two girls) recently bought a small (ten-acre) farm that they're fixing up. They've expanded the apple/peach orchard and grape vineyard and will plant a variety of perennial crops. They'll also throw in some chickens, bees, cows and other farm type beasts. Roy's not sure how much of his electrical engineering degree will help but you never know.

In May 1990, **Jay Adams** married Betsy Arnold, a nurse he met in Colorado. **Chris Winter**, **Tom McKendree**, **Rob Bishop**, '87, **Carlos Montero**, '87, **Ed Humphrey**, and **Geoffrey Englestein** attended. Jay is now in Pittsburgh getting a PhD in electrical engineering from Carnegie-Mellon. Tom spent ten weeks last summer at York University in Toronto at the International Space University. These ten weeks were substantially more intense than a semester at MIT. ISU is an international

program that travels every summer. ISU '88 was held at MIT. Geoff married Susan Nover in September 1990 and bought a house. Tom, Carlos, Ed, and Rob also showed up at this wedding. Geoff and Susan spent their honeymoon in Italy.

**Ray Schmitt** is now a VP at JP Morgan. . . . **Ellen Epstein** graduated from Wharton this spring. . . . **Anne Fricker** is still at Clorox and living in Oakland, Calif. I've been going to San Jose quite a lot and have met Anne at the Tied House (along with Anne's sister Ruth, '85, and Neil) and the Nordstrom Rack. She's also been entertaining my husband, Erik, as he goes up there more often than I do.

Thanks for all the news.—**Mary C. Engebret**, secretary, 1805 Manhattan Ave., Hermosa Beach, CA 90254, (213) 376-8094

## 87 5th Reunion

Hope you're enjoying the summer. Write me a letter and tell me all about it!

Welcome home to **Jon Athow**! Jon returned from deployment to the Middle East in support of Operation Desert Shield while serving aboard the frigate U.S.S. *Reasoner*, homeported in San Diego.

**Connie Perrier** called to fill me in on what she and some of her friends have been doing. Connie is enjoying her first year of Columbia Business School. Also studying there are **Kevin Murphy** and **Greg Stewart**, '86. . . . **Jennifer Buchner** married Gary Siegal last March, and they are living in Metuchen, N.J. Jennifer is working at Bell Labs. . . . **Debbie Bontempu** graduated from Columbia Law School last June 1990 and is now working for the patent law firm, Fish and Neave, in New York City. . . . **Louise Shin** plans to marry **Chun Oh** in June 1991. Congratulations! Louise and her husband will be living in New York City. . . . The *Concord* (Mass.) *Journal* printed an article by **Julie Marquet** on her life as a Peace Corps volunteer in the Dominican Republic. She is now in medical school at the University of Virginia.

And now, some fascinating facts sent in by your classmates. (You, too, could write to your class secretary to spread the word about your latest endeavors.) . . . **Dave Luneau** is a senior engineer for Summa Four, Inc. in Manchester, N.H. On September 29, 1990, he married **Henrietta V. G. Walsh** (Wellesley '88) at St. Matthew's Cathedral in Washington, D.C. Congratulations! . . . **Laurie Heller** is in graduate school at the University of Pennsylvania, getting a PhD in psychology. She plans to marry **Michael Terr**, PhD, '89, from the Cognitive Science Department at MIT, in June 1991. Congratulations!

**Michael Hollins** is working for General Atomics in chemical demilitarization, building a robot that will be part of a system that destroys old chemical weapons. He recently presented the work to a delegation of Soviet scientists. . . . **Steven Friedman** received a master's in electrical engineering from Cornell in 1989. Since then, he has been working in Annapolis, Md., for Aeronautical Radio, Inc., as a senior staff engineer. . . . **Joseph Morgan** is living in Norfolk, Va. He is in the Navy on board the submarine, U.S.S. *Key West*.

**Vic Christensen** writes from either Dayton, Ohio, or San Pedro, Calif.: "I was in Washington, D.C., for the 13th National Computer Security Conference in late September and met up with **Chris Guaning**, '82, who used to work in the same organization, the same building, doing the same job as I did before I switched jobs at Wright-Patterson AFB, Ohio. I also met **Heidi Peterson Leh** (Harvard '78), and we all got along fine. Of course, Chris and I had to poke some fun at Hahvahd! 'Ye ol' school up the Chuck! It was a good time!"

**Correction:** In a recent edition of the *Review*, it was incorrectly stated that **Hal Cohen** is working in an engineering firm in the New York City area. It should have stated that Hal Cohen (alias Mr. X)

is working for Prudential Bache in New York City. We deeply regret this error. In the event that other errors are spotted in this column, please let me know.

All right, gang, now it's your turn. Send in those letters! Write me at: **Stephanie Levin**, secretary, 393 West End Ave., Apt. 8B, New York, NY 10024, (212) 595-3172

## 88

Greetings from New York! I hope everyone's summer is going well. I just returned from a week-long trip in Utah with a bunch of med school friends. Tons of sun and snow. . . the conditions couldn't have been better. I ran into **Andrew Chang** on the slopes of Snowbird. He was out for a week with friends from Johns Hopkins Medical School. He says he is enjoying medical school and considering going into general surgery. . . **Christine McIntyre** is doing well in Michigan and wants to go into pediatrics. I'd love to hear from more of you and what specialties you're considering, so please write!

**Daniel Dismukes** is living and working in Yonkers, N.Y., for Loral Corp. on "some top secret projects." He has been dating a NYU Law School student and "things are getting pretty serious," we're talking wedding bells! Congrats! He visited **Chuck Venditti** for Super Bowl weekend. Chuck is doing molecular biology research at Penn State on the AIDS virus and hopes to have a doctorate within two months. He plans to get married soon afterwards. . . **Douglas Bank** married Susan Kahn (Brandeis '87) in November 1989. He is still working for Motorola in the Private Systems Division. I guess congratulations are due all the way around!

**Michael Warszawski** changed jobs in October and now is assistant VP at the Citicorp Technology Office in New York City. He says hello to Chi Phi, the Music Department and the MIT Community. . . **John Joseph** is currently in his second semester of graduate work in electrical engineering at USC. He expects to receive a master's in May 1991. . . **Ellen Lin** has joined the GE Research and Development Center as a mechanical engineer and is living in Schenectady.

**Sandra Lippka** received a master's in mechanical engineering from Texas A&M and has been working for the McDonald Douglas Space Assistance Co. While at MIT, she won the Admiral Luis de Florez Award for designing a self-adjusting variable-height gangway system for handicapped passenger access to Boston Harbor ferries. This work has recently been patented. Her goals for the future mainly involve "designing things."

Thanks to all who've written, and I hope to hear from more of you soon! Note the new address: **Grace Ma**, secretary, 545 1st Ave., 6P, New York, NY 10016, (212) 447-1925

## 89

This issue is the last of the free issues that we'll be receiving. Subscriptions can be extended with an annual donation of \$25 or more to the Alumni/ae Fund, which you can specify to go to the Class of '89 Scholarship Fund. So please keep in touch, and keep reading *Tech Review*!

The latest typo someone wrote to point out was the fact that my own name was misspelled! I haven't changed it, it's still Henry, as opposed to Kerry. Please keep that news flowing, though, even if there are no typos or errors! Thanks to everyone who wrote this month.

**Eric Tang** went skiing at the end of March and had a really wonderful time, despite having gotten only two hours sleep the night before. Eric lives in Cambridge along with housemates **Dave Brancaccio** and **Jean Lee**, '87. In addition to skiing, Eric has been watching anime, Japanese animated films, at the MIT Anime club; and has been looking for a change from paperwork at Raytheon in

Marlborough. Dave is finishing a master's at MIT and will be accepting a staff position at MIT's Lab for Manufacturing and Productivity. Dave keeps busy with thesis and figure skating. Eric sends along a lot of news. . . **Mike Williamson** and **Sue Streisand** passed their electrical engineering qualifiers at the University of California at Berkeley. On the side, Mike works on conceptual design for Berkeley's solar car. . . **Jessica Hirschfelder** is also at Berkeley finishing a nuclear engineering degree. . . **Jordan Drachman** is out at Stanford.

**Thao Nguyen** is in med school in Houston, Tex. She really misses playing volleyball and the convenience of electronic mail. . . **Vince Chau** is swamped with work at med school in Chicago, Ill. He's studying for his board exams and is looking for a new apartment. . . **Linh Giang** is working on a computer science master's at Cornell through AT&T's One Year On Campus (OYOC) Program. She hopes to finish by the end of the summer.

**Kris (Sheahan) Maeda** visited the States from Toshiba, Yokohama, Japan, where she lives with her husband, John Maeda (MIT, SM). She had plans to integrate computers into an elementary school curriculum through various multi-media applications. She has been reading manga and watching anime. . . **Kevin Li** is working on a PhD in electrical engineering at MIT. He recently flew out to Monterey, Calif., to present research work at an E&M conference. . . **Sue Lee** has been promoted to her job at Teradyne in Boston, Mass. Both Kevin and Sue have been avid skaters and skiers this season.

**Victor Liao** is the 6.111 head teaching assistant, and the newly redesigned lab 4 now plays music! Victor is busy juggling TA duties and classes, and has been skiing and playing volleyball. . . **Tom Manshrek** is out at Berkeley looking for a job and is planning on staying in northern California. . . **Kurt Roth** is in grad school at MIT, in the mechanical engineering department. He'll be graduating in June '91 with a master's, and will continue at MIT for a PhD.

**Tim Horgan** was married May 21, and is working for LC Services, a chemical company in Woburn, Mass. . . **Ron D'Agostino** is going to Boston University for a graduate degree in physics, and is engaged to Cheryl Mandel. . . **Jeff Alexander** is working on a graduate degree in computer science. . . **Anant Dighe** is at Washington University in St. Louis working in the MD/PhD program. Anant is enjoying himself and reports cheap rents and spacious apartments.

**Howard Gerber** is working as a data communications supervisor at Morgan Stanley, Inc. Howard has recently been certified as a scuba diver, and dove the "Great Wall" off the Bahamas. . . **Tim Steele** is working for NCR with Mini Gupta, '90. Tim has hit the sand volleyball courts for the first time this year in Atlanta, and went out to San Francisco in February to visit **Jean Kim** and **Marcia Smith**. . . **Mark Levine** is programming for Microsoft in Redmont, Wash., and is playing lots of volleyball and walleyball.

**Lissa Sabia** is finishing up a master's at Berkeley. Lissa sees **Annabel Nickles** and **Dan Garcia** every now and then, and reports that everyone is busy. Lissa isn't sure what she will be doing upon graduation, but she says she'll hopefully be doing something space related. . . **Phil Kuhn**, **Bill Maney**, **John Flight**, **Angeli Salgado**, **Elizabeth Greyber**, **Ron Koo**, and **Dan Mittleman**, '88, drove from the Bay Area to Portland, Ore., in late March to attend the housewarming party of **Steve Payne** and **Ray Veith**. Ron sent a card from Portland of Mt. Hood, and reports that the scenery en route is gorgeous.

**Mary Condello** and **Jeff Gealow** were married in June. Mary will be entering her third year of medical school at Tufts, and Jeff finished his co-op assignment with IBM and is now back at MIT working on a PhD in electrical engineering. That's all the news. Now that summer's here, I hope everyone will write about their trips and vacations. See you in August (please send in those

subscription renewals to the Alumni Fund!).—**Henry Houh**, secretary, 14 St. Paul St., #1, Cambridge, MA 02139, (617) 661-1691, e-mail:tripleh@athena.mit.edu

## 90

Marine second lieutenant **George J. Tomas** has just graduated from the Basic School, which is located at the Marine Corps Combat Development Command in Quantico, Va. This 26-week course prepared George for assignment to the Fleet Marine Force. Subjects George studied in the course included land navigation, military law, Marine Corps history, and traditions and tactics.

**Brian Kitchenka** writes that he spent the summer after graduation serving as a missionary in Healy, Alaska. He then spent some time in the fall working in Foxborough, Mass., as a substitute teacher while waiting for an assignment from the Air Force. In December, Brian reported to Texas to attend technical training before he goes on his first assignment. Brian also writes that **Gary Robinson** is an engineer in Dallas and **Scott Stevens** is also waiting for his Air Force assignment.

It looks like many of us decided to stay in school. **Scott Carroll** is taking classes through the Harvard Extension Program. . . **Fred Kennedy** is at MIT working on a master's degree. . .

**Mike Sadlowski** is studying at Purdue University, and **Ellen O'Connell** is working toward a PhD in chemical engineering at the University of Wisconsin in Madison. . . At the University of Massachusetts Medical School we find **Helen Delichatsios**, and at MIT, working under Professor Arvind, is **Alex Caro**. . . **Larry McKay** is studying at Brown University.

**Scott Hochgesang** writes that he's working for LEK Partnership in Los Angeles. Scott's also busy going to Laker games, snow skiing, and just hanging out in the hot tub that's on the roof of his apartment building. In December, Scott had a big Christmas party at his home in Indiana. **Erik Saarmaa** and **Rob Bettiker** were among the people that were there. Erik is working in Cambridge for Payload Systems Integration and consulting in aero/astro lab, while Rob is working in a University of California, Berkeley, lab. . . **Peggy Liu** also writes from Los Angeles. Peggy's been busy working as a consultant at McKinsey and Co. Work has taken her to London, Paris, San Francisco, and Las Vegas. In her spare time, Peggy has fun club hopping, exploring restaurants, hiking, and rollerblading on beaches.

**Elena Koutras** has been working in Reston, Va., as a staff engineer at the Harris Group. She's one of nine people in the Engineering Division, which specializes in facilities planning. Elena writes that she enjoys her job and that there's always a lot to do in the Washington, D.C./Virginia area. . . **Denise Kato** is working in Denver for Martin Marietta Astronautics Group. In her spare time, Denise has been hitting the ski slopes in Summit County and volunteering as a math and science tutor for high school students. In late January, Denise spent a weekend in Los Angeles visiting **Jennifer Wright**, who is working for Hughes Space & Communications in El Segundo. In L.A., they got together with **Rich Pemberton**, who is working for Northrup, and **Scott Hochgesang**. Denise also flew out to Midland, Mich., to visit Jeff Pribble, '89, and Vic Barocas, '88.

Also in the working world. . . **Joe Kowalski** is working for Ford Motor Co. near Detroit, and **Shawn Birchenough** is working for Booz Allen & Hamilton in Virginia. . . **Yeuk Yuan** is at Oracle near San Francisco, and **John Wang** is at Acer America in Silicon Valley. . . **Mark Sexton** is working for Raytheon in Massachusetts. In August, Mark was married to Patti Fix.

Congratulations to **Michael Valdez**! Michael is the recipient of an NSF Minority Graduate Fellowship.

Thanks for all the letters! Keep them coming!—**Ning Peng**, secretary, 409 Argyle, Mineola, NY 11501, (212) 745-2704 (w), (516) 877-0444 (h)

## I CIVIL ENGINEERING

**Saturnino Suarez Reynoso**, SM '76, sends word from Mexico: "I changed jobs from construction to industry one and a half years ago. I am now the general director for three steel manufacturing companies, and am undergoing a new training phase learning a new trade. All this and I am still with the ICA group where I have worked since returning from MIT." . . . **Dianne Tobey Covault**, SM '90, writes in from Evanston, Ill.: "After finally completing my master's thesis last August, my husband Corbin Covault, '85 (VIII), and I, along with our golden retriever pup, Munro, and cat, Buff, moved out here to the vast Midwest. I am now an environmental engineer at Camp Dresser and McKee, Inc., who's headquarters are a mere three blocks from my old Parson's Lab haunt!"

**Carl A. Gowan**, SM '76, sends word from San Rafael, Calif.: "I started as an investment officer with L.G. Schafroth Partners, a venture capital real estate firm with offices in New York City and San Francisco, after five years with Bank of America as a VP/acquisitions officer in investment real estate. I am happily married to Donna and we have four children, Dustin, 10; Carrie, 7; Jason, 4; and Jennie, 7 months." . . . **Kenneth Reinschmidt**, '60, president of advanced systems development services at Stone & Webster, has been elected to the National Academy of Engineering. The academy now has 1,580 members. . . . MIT has announced the creation of a new interdisciplinary research effort—the MIT Innovative Structures Program—focused on science-based technologies needed to build an entirely new generation of structures for the 21st century. The structures involved range from innovative housing and highly durable infrastructure facilities, such as highways and bridges to super-tall buildings, mega-span bridges, and extraterrestrial bases and habitats. Civil Engineering Department Head **Jerome Connor**, '53, was the sponsor of the initiative.

**Robert E. McPhail**, SM '67, of North Andover, Mass., died in January 1991. McPhail was piloting a twin-engine plane carrying his wife, Linda, and another couple that crashed during an aborted landing attempt in Lantana, Fla. He owned McPhail Associates, a Cambridge-based engineering firm. They were avid travelers and bridge players. Their neighbors remember them as kind people who "lived their life to the fullest."

## II MECHANICAL ENGINEERING

**Dionissios N. Assanis**, SM '83, writes: "I was promoted to the rank of associate professor with tenure in the Department of Mechanical Engineering at the University of Illinois at Urbana-Champaign. I was also honored with the 1990 ASME/Pi Tau Sigma Gold Medal Award for outstanding achievement in mechanical engineering within 10 years after graduation." . . . **Ronald G. Nitschke**, SM '87, reports: "GM formed an engine division in the Advanced Powertrain Division. We are working on late 90's stuff (passenger car engines)." . . . **C. Eric B. McConachie**, SM '51, reports from Montreal: "I rejoined Canadair in 1988 (after operating my own aviation consulting firm in Montreal for 21 years) as VP for marketing and customer support for a new 50-seat

regional jet. The program is now well launched and the first flight is scheduled for spring '91 with deliveries starting mid '92. New assignment with RJ program is VP for strategic market development, primarily concerned with new models of aircraft." . . . **Carl C. Hiller**, PhD '76, writes: "I got married for the first time in July 1990!"

**Patrick R. Turner**, SM '85, sends word: "I was promoted at the end of 1990 to the position of engineering director of Interface Products for Mechanical Dynamic, Inc., of Ann Arbor, Mich. MDI develops and markets MCAE software for multi-body system analyses." . . . **Keith A. Morris**, SM '82, reports: "I recently returned from two years working in Japan. Our daughter, Anna, was born there last year. I've started a new company that develops and markets industrial automation sensors, systems, and software." . . .

**Robert C. Downs**, SM '80, was one of five Saturn team members honored with General Motors' "Boss" Kettering Award for patented inventions that proved to have outstanding value in 1990. Downs is an executive engineer in the Automatic Transmission Systems division. According to a company press release, he was part of the team honored for "their contributions to the development of electronic controls for Saturn's all-new four-speed automatic transmissions, which offer customers the performance and fuel-economy characteristics of many manual transmissions with the convenience of automatic shifting." Downs began his career at GM in 1979 and joined Saturn in January 1986. . . . **William B. Rouse**, PhD '72, has been elected a member of the National Academy of Engineering. The Academy cited Rouse for his "pioneering development of models of human-system interaction for applications in complex engineering systems." Rouse is chair and chief scientist at Search Technology in Atlanta, Ga. His responsibilities include strategic planning and new business development for the multi-million-dollar contract R&D and engineering services company.

MIT Professor of Mechanical Engineering **Frank A. McClintock**, '42, was recently elected a member of the NAE. He was cited "for pioneering and sustained contribution to the understanding of the process of ductile fracture of engineering materials." . . .

The Alumni/ae Association has been notified that **Long-Chain Chen**, PhD '88, of Bowling Green, Ohio, died on February 4, 1991. There was no further information provided.



W.B. Rouse



R.C. Downs

## III MATERIALS SCIENCE AND ENGINEERING

**Harold D. Brody**, '60, professor of materials engineering at the University of Pittsburgh, has been named the eighth dean of the School of Engineering at the University of Connecticut. Brody has been a faculty member since 1966 at the University of Pittsburgh, where he taught metallurgy, materials processing, and engineering design. Since 1983 he has been director of the Casting Industries Science and Engineering Institute. Since 1987 he has also held a part-time faculty appointment in materials science and engineering at MIT where he collaborates on solidification research programs. . . . **Gordon E. Forward**, ScD '66, is a new director of Texas Industries, Inc., in Dallas. He continues as president and CEO for Chaparral Steel Co. in Midlothian, Tex. . . . **Thomas J. Warren**, '82, is one of three recipients of the 1990 ASTM Sam Tour Award. According to an ASTM press release, "the award is given to an author of a technical paper, published by the society, of outstanding merit in the field of improvement and evaluation of corrosion methods." Warren and his two coauthors received the award for their paper "Determination of the Loading Rate Needed to Obtain Environmentally Assisted Cracking in Rising Load Tests," *ASTM Journal of Testing and Evaluation*, July 1989. For the past five years Warren has been employed as a consultant by Arthur D. Little, Inc.

The American Physical Society has honored **Watt W. Webb**, ScD '55, and **Edwin L. Thomas**. Webb, of Cornell University, has been named the recipient of the 1991 Biological Physics Prize. The citation reads, "for his seminal work on the biophysics of cell membranes and cell motility, for his dedicated training of future generations of critical biophysicists, and for his longstanding contributions to the biophysics community." Thomas, an MIT Course III professor, has been named the recipient of the 1991 High Polymer Physics Prize by the APS. His citation reads, "for his outstanding contributions to elucidation of microstructure in polymeric materials through development and application of innovative electron microscopic techniques."

**Maurice C. Fuerstenau**, '57, a University of Nevada professor, has been elected to the National Academy of Engineering. The Academy now has 1,580 members.

**Gilbert R. Speich**, ScD '58, of Naperville, Ill., died on February 16, 1990. There was no further information provided.

## IV ARCHITECTURE

**Aron Faegre**, MAR '76, writes: "Paul Ries, MAR '89, has joined my office (Aron Faegre & Assoc.) and is project architect on an estuary interpretive center project and an emergency communications center project." . . . **Peter L. Abeles**, MCP '58, reports: "I have recently been a consultant to the U.S. Agency for International Development to provide housing assistance for Russian immigrants in Israel."

**Ben Olasov**, SM '89, sends word from New York City: "I am director of R&D for Syska & Hennessey Engineers, Inc. The company is involved in many progressive R&D activities." . . . **Masood A. Khan**, SM '83, reports that since Sep-



C. Shen



A. Pines

tember 1988, he has been a Course IV lecturer in the School of Architecture and Planning. . . . **Kathleen C. MacNeil**, SM '88, has been made an associate at Macomber Development Associates. She was formerly project manager for the Cambridge-based company.

**ELS/Elbasani & Logan Architects**, a Berkeley-based architecture and planning firm, has received the 1991 Firm Award from the California Council of the American Institute of Architects (CCAIA). According to a company press release, "The Firm Award is the highest honor CCAIA bestows upon an architectural firm. This award recognizes outstanding achievement in architectural design as expressed in a body of work produced by an individual firm for a period of 10 years or more, either under the direction of a single principal or as a collaboration between principals." One of the three company principals, **Carol Shen**, MAR '71, spoke at the award design conference. Shen has managed a number of the projects that ELS has designed throughout the West Coast including Pioneer Place in Portland, The Shops at Arizona Center in Phoenix, the Ala Moana renovation in Honolulu, the Crocker Galleria renovation in San Francisco, and the U.C. Press Headquarters in Berkeley. Shen has also been the principal responsible for most of the firm's activities in Asia to date. She has worked on designs in Tokyo, Kuala Lumpur, and Sentosa, and is currently principal-in-charge on the Clarke Quay restoration in Singapore. **Alex Achimore**, '72, is an associate principal with the firm.

## V CHEMISTRY

**Robert R. Moore**, PhD '86, writes: "I graduated from UMass Medical School in 1989 and am currently a family practice resident in the UMass/Fitchburg program. In August 1990, my wife, Donna, gave birth to a little girl, Jill Elizabeth." . . . **Barbara Benjamin Kops**, SM '80, sends word from Amsterdam: "I married Robert A. Kops, manager of KLM Freight, and we have two children, Jennifer Ann and Brian Neil. We just bought a house in the lovely Dutch village of Ouderkerk aan de (on) the Amstel. We are fluent in Dutch, of course." . . . **Robert A. Duce**, PhD '64, has been named a Fellow of the American Geophysical Union in Washington, DC. He is vice-provost for Marine Affairs and dean of the Graduate School of Oceanography at the University of Rhode Island in Narragansett. . . . **Harold R. Ward**, PhD '61, has been named a distinguished alumni of Mt. Vernon Township High School in Mt. Vernon, Ill. Ward is director of the Center for Environmental Studies at Brown University. . . . **Lionel Galstaun**, PhD '36, was given the St. James Award by the St. James Armenian Church of Westchester, N.Y. Galstaun, a life-long engineer, has maintained an active role in the church, most recently as chair of its parish council.

The Pfizer Career Development Chair, which Pfizer, Inc., has endowed since 1987, has been renamed the Pfizer, Inc.-Gerald D. Laubach Career Development Chair. The renaming is a tribute to **Gerald D. Laubach**, PhD '50, as he closes out his

40-year career at Pfizer where he has been a board member since 1968. He was named president of Pfizer Pharmaceuticals in 1969 and president of Pfizer in 1972. Laubach joined Pfizer in 1950 upon his graduation from MIT and retired this past February. The chair provides an opportunity to identify and support promising MIT faculty as they develop their careers in biology and chemistry. . . . **Alexander Pines**, PhD '72, professor of chemistry at the University of California at Berkeley, has been named a co-winner of the prestigious Wolf Prize for chemistry in 1991. Pines, who is also a senior scientist at the U.C. Lawrence Berkeley Laboratory's Materials Sciences Division, will share the \$100,000 award with Richard R. Ernst of Switzerland. According to a U.C./Berkeley press release, "Pines is being honored for his revolutionary research in using nuclear magnetic resonance to reveal the chemical structure of solids, which has applications in plastics, petroleum, and ceramics."

**Albert C. Zettlemoyer**, PhD '41, of Bethlehem, Pa., died on January 27, 1991. A distinguished professor emeritus of chemistry at Lehigh, Zettlemoyer began his academic career at the university in 1941 and went on to earn national and international recognition for his research. He published more than 230 technical articles, eight book chapters, and held 10 patents. Well-known as a surface and colloid chemist, he was honored many times for his contributions to the printing ink industry and directed cloud-seeding projects to manage rainfall. A member of several national and international societies, Zettlemoyer was most active in the ACS, in which he served for more than 50 years, one of them as president. As a teacher he directed more than 50 doctoral candidates and 100 master's degree students. In large undergraduate classes, he was known to seat students in reverse alphabetical order, "a protest," he said, "at my having been in the back of the room in so many cases when I was a student."

**Edmund Lee Gamble**, PhD '32, professor emeritus of inorganic chemistry, died of cancer on November 28, 1990, at the age of 84. He was a resident of Marstons Mills, Mass., at the time of his death. A member of the chemistry faculty from 1937 to 1971, Gamble taught the freshman subjects for more than 20 years. He also served as master of Baker House for a number of years. . . . **Chapin A. Harris**, PhD '39, of Plymouth, Mass., died on July 10, 1990, after a long illness. He was employed as a research chemist at the Plymouth Cordage Co. until 1947 when he joined the faculty at the Lowell Technological Institute and began research on synthetic fibers. He served as dean of the faculty and as director of the graduate school during his tenure at the Institute. He was a member of a team hired to rehabilitate the Seoul National University School of Textile Engineering in South Korea. . . . **Thomas H. Regan**, PhD '55, of Fairport, N.Y., died on September 27, 1990. There was no further information provided.

## VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

**Rudolph J. Cypser**, ScD '53, reports that he is now publishing another book, *Communications for Cooperating Systems* (Addison-Wesley). . . . **Ying-Ching Eric Yang**, PhD '89, a postdoctoral research scientist in the Research Laboratory of Electronics, won the 1990 Booker Fellowship of the International Union of Radio Science. Award of the fellowship enabled Yang to attend the organization's general assembly in Prague, Czechoslovakia. . . . **William R. Broyles**, SM '65, has joined the GE R&D Center as a project development manager. Previously he was employed by GE Defense Systems in Pittsfield, Mass., for 16 years where he held several managerial positions in engineering, programs, and marketing. . . . **H.S. Magnuski**, PhD '73, has resumed his former position as president and CEO of GammaLink. He previously held the title of president from December 1984

## Wormley Named Associate Dean



**M**echanical Engineering Department Head David Wormley, '62, has been named the new associate dean of the School of Engineering. Wormley is widely recognized for his research in control, transportation, and fossil fuel energy systems. He has led his department since 1982 and will continue to do so during the search for a new head.

In a letter to the faculty announcing the appointment, the new dean of engineering, Joel Moses, PhD '67, said "Dave Wormley was the overwhelming choice of the many members of the faculty and administration whom I have consulted." In addition to doing an exceptional job in his present position, Moses said, "he is an excellent teacher and has won two Graduate Student Council Awards for Outstanding Teaching. . . . He is widely recognized as a person with great judgment. It will be a pleasure sharing the dean's office with him."

Wormley has been co-chair of the Science-Engineering Working Group (a committee that in 1989 made recommendations concerning the science and engineering core subjects) and is currently is chair of the Education Committee for the School of Engineering. He is also director of the Association of American Railroads Affiliated Laboratory at MIT. Wormley's research has included the development of sensors and actuators for advanced control systems, control modeling and simulation techniques for fossil fuel power systems, and analysis techniques and experimental evaluation methodologies for transport vehicles and guideways. □

# A Whole New Ball Game for the Materials Processing Center

Ten years after it was founded to help bring new science into the quest for high-tech materials, the MIT Materials Processing Center (MPC) is bracing for a landmark change in its mission. Opportunities for harnessing science to the processing of materials are by no means fully exploited. But Professor Ronald M. Latanision, MPC director, setting the themes last fall on the center's 10th anniversary, called for a revised research agenda that focuses on "new national priorities driven by industrial competitiveness, product quality, environmental harmony, energy conversion, and the development of human resources."

"From an engineering point of view," says Latanision, "the object of materials processing continues to be controlling the structure, shape, and properties of materials." But now, more than before, he says, we have to do these things "in cost-effective, socially responsible ways."

Leading a panel of experts at a symposium to mark MPC's first decade, Professor Julian Szekeley forecast a new emphasis on goals such as recyclability, energy efficiency, and limiting the pollution and waste associated with processing materials. Robert A. Laudise, PhD '56, director of the Materials and Processing Research Laboratory at AT&T Bell Labs, agreed. He sees a new and increasingly irresistible demand to make minimal environmental impact a requirement instead of an afterthought in the design and operation of industrial processes and products. Environmental issues that have tended to be adversarial are suddenly becoming everyone's concern, Laudise said.

To John Riggs, vice-president for research at Hoechst Celanese Corp., the major issue for the 1990s is competitiveness, and as far as materials are concerned that comes down to reducing the time it takes to bring new developments into new products. He hopes MPC can shed some light on why the United States is slower than other countries to commercialize its new technologies—and, of course, provide ideas for what to do about it. Professor Joel P. Clark, ScD '72, director of MIT's Materials Systems Laboratory, provid-



Ron Latanision, director of the Materials Processing Center, is seated in front of an ellipsometer, a device for studying the thickness of surface films on solids.

ed a slightly different formulation of the same question: "Why is the U.S. so weak in materials technology despite our success in materials science?" he asked.

Two developments together create an unusual "window of opportunity" for materials science to tackle these issues in the first half of the new decade, said Bill R. Appleton, associate director of the Oak Ridge National Laboratory. One is the nation's new concern for the quality and competitiveness of everything we make, the other a new demand in Washington for greater cooperation between industry and academic institutions in materials science. It's a unique opportunity for groups like MPC, said Appleton. "If we miss this train, there won't be another," he warned. "We'll be left at the platform."

George B. Kenney, '74, associate director of MPC, offers two topics he thinks will be emphasized in MPC's research—technological goals that are simple to state but almost surely elusive to achieve: reducing the need for tox-

ics such as heavy metals and CFCs in making electronic circuits and components, and substituting water-based systems for the organic solvents that are now standard for cleaning materials and products of all kinds. It's problems like these that will make materials science "a whole new ball game," Kenney says. "And the changes have to be made soon—I mean starting now."

MPC approaches this new landscape with a strength that its founders hardly could have promised a decade ago. It's now MIT's third largest interdisciplinary center, with annual funding of \$7.5 million, according to Kenney. Some 80 firms in a broad-based consortium sponsor fully 30 percent of MPC's research. The consortium also funds up to eight annual fellowships for MIT graduate students as well as summer scholarships for about the same number of undergraduates from other institutions—many of whom later come to MIT for graduate work.—John Mattill □

to August 1987. Magnuski was most recently chief technical officer for GammaLink of which he is a co-founder. The company, based in Sunnydale, Calif., is the originator of PC-to-fax technology and a manufacturer of fax boards and fax software.

**Perry Miller**, PhD '73, has been named the first director of the Center for Medical Informatics at the Yale School of Medicine. According to a Yale press release, "The center will provide intellectual leadership in the creative application of computers in biomedicine. Through Miller's efforts, the center will focus on the emerging field of biomedical information technology, incorporating patient care, research, medical education, scholarly information, and computing and communications." Miller joined the Yale medical faculty in 1981. A particular focus of his research has been to develop advice-giving programs that critique a physician's plan for patient care. Instead of trying to tell a physician what to do, a critiquing program first asks the physician what he is planning to do, and then discusses that plan. In this way the computer is able to structure its advice around the physician's own thinking and style of practice. . . . **Bruce A. Black**, SM '66, has been promoted from associate professor to professor in the Department of Electrical and Computer Engineering at the Rose-Hulman Institute of Technology in Terre Haute, Ind. Black has taught at the institute since 1983 and currently teaches classes in communication systems, digital system design, computer architecture, and data communications. His promotion will be effective September 1, 1991.

**Rudolph Kalman**, '53, a University of Florida professor, **James Massey**, PhD '62, a University of Zurich professor, and **Charles A. Zracket**, SM '53, a Mitre Corp. trustee, have been elected to the National Academy of Engineering. The Academy now has 1,580 members. . . . Hitachi America, Ltd., of Tarrytown, N.Y., has established the Hitachi America Professorship of Engineering at MIT through a gift of \$1.5 million. The first holder of the professorship is **Albert R. Meyer**, professor of computer science in Course VI. Hitachi has been a member of MIT's Industrial Liaison Program since 1976. Meyer is a leading researcher at the Laboratory for Computer Science and is known internationally for his work in theoretical computer science. He has been a member of the faculty since 1969. In 1972, Meyer discovered the first example of a computational problem which, although solvable in theory, was inherently unsolvable without astronomical computational effort. His work in this area established him as a leader in computational complexity.

## VI-A INTERNSHIP PROGRAM

As this is written, in the middle of March, the process of selecting this year's applicants for admission to VI-A is nearing completion. One hundred ninety-seven, of 325 Course VI sophomores, applied (60.6%) and about 80 of these (41%) will be matched with their company preferences for this year's new VI-A Class. The number of applicants is up 2% from 1990 from an EECS sophomore class that is 22% larger than last year. . . . The annual VI-A business dinner, which followed the afternoon business meeting conducted by Director O'Toole, was a delightful affair of about 90 people held in the Mezzanine Lounge of the Stratton Student Center. This was followed by the Company Open House, in the expansive Sala de Puerto Rico, where the company representatives met informally with the applicants prior to their next days of formal interviews.

It was good to have, again, many of our VI-A alumni representing their companies. As best as we can compile (we asked for business cards), the following were here: **Michael P. Chin**, SM '87, (AT&T Bell Labs.); **Patrick J. Cobler**, SM '90, (Loral Info. & Imaging Systems); **Dean R. Collins**, SM '59, (Texas Instruments); **Dean S.**

**Daniels**, SM '82, (IBM/Almaden Research Labs); **Chester M. Day, Jr.**, SM '58, (Bell Communications Research/Bellcore); **Charles B. Dietrich**, SM '58, (David Sarnoff Research Center); **Jenny M. Ford**, SM '82, (Motorola/Phoenix Semiconductor Production Sector); **Neil M. Haller**, EE '61, (Bell Communications Research/Bellcore); **Tomohiro Hasegawa**, SM '85, (H-P Medical); **Gordon S. Jackson**, SM '84, (Raytheon); **Ellen B. Leckband**, SM '80, (H-P Medical); **Ruby Li**, SM '88, (DEC); **Steven L. Rohall**, SM '88, (Bell Communications Research/Bellcore); **Nancy S. Stevens**, SM '82, (Saraf) (AT&T Bell Labs); and **Craig L. Zarmer**, SM '84, (H-P Labs).

Faculty and alumni continue to provide news for our Honors & Awards paragraph. At a recent Department Colloquium, Department Head **Paul L. Penfield, Jr.**, ScD '60, announced that Professor **Hermann A. Haus**, ScD '54, will be this year's recipient of the IEEE's prestigious Education Medal. A congratulatory surprise reception was held for him immediately following the colloquium. You may recall that the late Professor **Richard B. Adler**, ScD '49, received this award in 1986, as did Professor **Alan V. Oppenheim**, ScD '64, in 1988. Elected a member of the NAE is **Bernard M. Gordon**, SM '49, president and CEO of Analogic Corp. and founder of The Gordon Institute.

**Andrew J. Viterbi**, SM '57, is the recipient of an honorary doctor of engineering degree from the University of Waterloo in Ontario, where he was the engineering commencement speaker; he also delivered the Shannon Lecture for the International Symposium on Information Theory in Budapest, Hungary—the highest recognition afforded by the IEEE's Information Theory Society. Current Course VI-A junior, **Saeed Nawaz Jaffer**, '92, has been named a 1991 Burchard Scholar by MIT's School of Humanities and Social Science. . . . We note that **Theodore M. Lyszczyk**, PhD '79, of Lincoln Laboratory, lectured at a VLSI Seminar on "Wafer-Scale Solid-State Mass-Memory System."

There have been many callers and/or visitors to the VI-A office since our last column. **Michael R. Crystal**, SM '87, was on campus recruiting for BB&N located in Cambridge, and is just back from an assignment in Morocco. He tells me his dad, **Thomas H. Crystal**, ScD '66, is on a two-year assignment as program manager for DARPA and is living in Falls Church, Va. . . . **R. Ellis DuPuy, Jr.**, SM '75, came in for a visit and discussion of career activities. . . . **Glenn A. Kramer**, SM '84, was on campus recruiting for Schlumberger Laboratory for Computer Science in Austin, Tex., and tells me he has completed his doctoral dissertation at Sussex University in England; it is to be published by the MIT Press. . . . I should also mention that during the VI-A recruiting, I had lunches with representatives **Dean R. Collins**, SM '59, of TI and **Burnell G. West**, '60 (VIII), of Sentry/Schlumberger, plus many pleasant reminiscences with our other (previously mentioned) VI-A alumni representing their employers.

From some of these I received suggestions for the possible 1992 celebration of VI-A's 75th anniversary. I encourage readers to communicate their own thoughts to me by writing, visiting, or phoning (617-253-4645).—**John A. Tucker**, VI-A director (Emeritus) & lecturer, MIT, 77 Mass. Ave., Rm 38-473, Cambridge, MA 02139-4307.

## VII BIOLOGY

**Clemens E. Prokesch**, SM '45, sends word from New London, Conn.: "I continue in the active practice of internal medicine and also am very active with my hobby of philately. I continue as VP of the German Society of Eastern Connecticut. . . . **Elizabeth V. Wattenberg**, PhD '89, reports that she is working as an environmental toxicologist at the Minnesota Department of Health. . . . **Marc Julius**, SM '66, has been appointed presi-

dent for market research and consulting at The Vanderveer Group, Inc., a provider of custom health care marketing research founded in 1979. A company press release reports that in 1988 and 1989, the Vanderveer Group was selected by *Inc.* magazine as one of the 500 fastest-growing companies in the U.S.

## VIII PHYSICS

**Michael A. Guerra**, PhD '76, sends word from Exeter, N.H.: "I am presently president and CEO of Ibis Technology, a company which I founded four years ago. It is the world's largest supplier of silicon-on-insulator wafers, which are used in the fabrication of high-performance circuits." . . .

**George D.J. Phillies**, '69, was promoted to professor of physics with tenure at Worcester Polytechnic Institute. His research interests include light-scattering spectroscopy, complex fluids, statistical mechanics, and polymer physics. A specialist in biophysics, Phillies has used laser spectroscopy to measure the speed of molecules moving through liquids. His theoretical work has been concerned with the diffusion of polymers in solution. He has been a member of the WPI faculty since 1985.

The South Carolina Council for the Institute of Electrical and Electronic Engineers has initiated three annual awards to help recognize those individuals and companies that have made the greatest contributions to electrical engineering within the state of South Carolina. **Jay W. Lathrop**, '48, professor emeritus of electrical and computer engineering at Clemson University, recently received the first Outstanding South Carolina Electrical Engineering Educator Award. Lathrop was selected because of his pioneering work in the development of the integrated circuit as well as his contributions to electrical engineering education in the state. The award will henceforth be known as the Jay Lathrop Outstanding South Carolina Electrical Engineering Educator of the Year.

**Raymond Goldstein**, '83, has been appointed an assistant professor in Princeton University's Physics Department. Goldstein specializes in condensed matter physics. He joined Princeton after working as an NSF postdoctoral research fellow at the Fermi Institute at the University of Chicago.

**Mehran Kardar**, PhD '83, Course VIII associate professor, has been selected as the first recipient of the Class of 1948 Professorship. He will hold the chair for a two-year term. The chair was established by the class in celebration of its 40th reunion. Kardar, a condensed matter theorist who works primarily on problems in statistical physics, has made important contributions in a wide variety of areas, including dynamics of growing interfaces, polymers in random media, morphological transitions in membranes, and the phases and phase transitions in thin films and layers. He was appointed to the MIT faculty as assistant professor of physics in 1986 and became an associate professor in 1990. His honors include an A.P. Sloan Fellowship in 1987, the Bergmann Memorial Research Award in 1988, the Presidential Young Investigator Award in 1989, and the Graduate Student Council Teaching Award in 1990. . . . **Richard E. Crandall**, PhD '73, has written *Mathematica for the Sciences* (Addison-Wesley, 1991). According to its jacket, the book "leads you through *Mathematica* examples from physics, biology, chemistry, mathematics, and engineering." Crandall holds the Chair of the Howard Vol- lum Professor of Science at Reed College, where he was the chief architect of the college's liberal arts computing plan. He is also an educational fellow and director of Scientific Computation at NeXT, Inc.

**Irvin H. Solt, Jr.**, PhD '55, of Los Altos Hills, Calif., died on October 5, 1989. He was known for his pioneering engineering development work that led to significant advances in high-capacity

# M E R C K

# 1

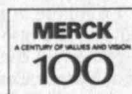
Thanks to the dedicated effort of our employees – including the 94 alumni of Massachusetts Institute of Technology – Merck has been voted “America’s Most Admired Corporation” in a *Fortune* magazine survey of 8,000 business leaders and financial analysts.

# 5

This is the fifth consecutive year that Merck – the world’s largest prescription pharmaceutical company – has been so honored.

# 100

As we celebrate our Centennial,  
we rededicate ourselves to the values that have built our corporate reputation  
in the categories of the *Fortune* survey†



†Community and Environmental Responsibility; Innovativeness; Quality of Products or Services; Value as Long-Term Investment; Ability to Attract, Develop, and Keep Talented People; Financial Soundness; Use of Corporate Assets; Quality of Management

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linear radio systems including single-sideband and digital microwave radio product technology. After graduating from MIT he worked for the Hughes Research Lab, where he designed and constructed magnetic resonance spectrometers for various solid state physics applications. He was also an employee of the Fairchild Camera and Instrument Co., where, as the general manager of the Microwave Products group, he directed pioneer work in broadband harmonic frequency multipliers using varactor diodes and developed the first microwave power transistor capable of delivering one watt at 1 GHz as an oscillator. In the 1970's he was VP of the corporation and president of the Telecommunications Division at California Microwave. Solt spent most of the 1980's working at Karkar Electronics in San Francisco as the VP for engineering. During this time he directed the first conversion of FM radios into single-sideband radios, which led to the company's long term relationship with MCI. When General Signal purchased Karkar and later consolidated it with Telecommunications Technology, Inc., Solt was VP for engineering and later VP for business development and CTO.

## X CHEMICAL ENGINEERING

**Ronald E. Rosensweig**, ScD '59, writes: "Ferromagnetics Corp. established a program of the Dr. Ronald E. Rosensweig Research Grants in recognition of my role in establishing the science and technology of magnetic fluids and their uses. Two grants were awarded to university investigators in 1990. I remain active in this field as a researcher, and in organization of international conferences (ICMF-6 Paris to be held in July 1992). At Exxon Corp. Research Labs I recently was the recipient of a unit service award for work relating to the innovative use of neural networks."

From Avon, N.J., **Stephen Amos Murtha**, SM '74, reports: "I have started a company, Simulation Tools, which produces process simulations for industrial operations training. These software tools run under the OS/2 operating system and support dynamic process simulation, graphical user interfaces, on-line tutorials, data collection, and report generation."

**Gerard C. Coletta**, SM '68, a VP with the FPE Group, a Philadelphia-based consulting firm specializing in broad areas of risk control, has been elected to serve on the board of trustees for the Institute for Standards Research (ISR), a subsidiary of the American Society for Testing and Materials (ASTM). His one-year term began last January. Coletta has been a member of ASTM since 1977. According to an ISR press release, "his responsibilities on the ISR board of trustees include reviewing research proposals submitted to the board that could ultimately strengthen ASTM standards and benefit standardization, industrial, commercial, and research communities as a whole."

**Robert A. Brown**, the Arthur Dehon Little Professor of Chemical Engineering at MIT and department head, was elected a member of the NAE. His citation read: "for application of computing techniques to fundamental and practical problems in fluid mechanics, rheology, and crystal growth." Brown, 39, is believed to be one of the youngest engineers ever elected to the NAE. He also received another honor recently, this one from The Ex-Student's Association of the University of Texas at Austin where he received his first two degrees. Brown was named one of the 1991 Outstanding Young Texas Exes. The award is given to "Texas Exes" who distinguish themselves in their profession before they are 40. The announcement from Austin cited Brown's NAE election, his work as co-director of the MIT Supercomputer Facility, and his involvement as a founding member with the Consortium for Scientific Computing at MIT. . . . **John E. Anderson**, '50, senior corporate fellow at Union Carbide

Corp., has been elected to the NAE. The Academy now has 1,580 members.

**Sheldon W. Dean, Jr.**, '58, of Air Products and Chemicals, Inc., in Allentown, Pa., has been named the recipient of the NACE Frank Newman Speller Award for 1991. "First presented in 1947 to Frank Newman Speller, a pioneer in corrosion engineering, this award recognizes individuals who have made a national or international contribution through some form of education or work promoting the development or improvement of a method, process, apparatus, type of equipment, or material that facilitates the control of corrosion," states an NACE news release. It goes on to say, "Dean's contributions to materials engineering include the development of a mass transfer model for predicting the corrosion of piping and tankage by sulfuric acid. An analysis of a superheater failure has led to his publication of design curves for a minimum temperature criterion preventing caustic stress corrosion cracking in stainless steel superheater tubes."

## XI URBAN STUDIES AND PLANNING

**Caren L. Mathis**, MCP '84, writes: "I left the State of Alaska's Department of Commerce & Economic Development as a special assistant to the commissioner and am now consulting to the city of Saint Paul on Saint Paul Island in the Pribilof Islands in Alaska." . . . **Basil J. Tommy**, MCP '79, is now deputy director of planning for the Massachusetts Turnpike Authority in Boston. Prior to this he was senior project manager for the Commonwealth of Massachusetts in the division of Capital Planning & Operations. . . . **Rosemary Cashman**, MCP '87, has been appointed acting town administrator of Weston, Conn. Her stint is expected to last four to six months while the town administrators seek a permanent appointee. Cashman will be a candidate for the permanent position.

## XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

**William E. Hardy, Sr.**, SM '49, of Pickens, S.C., died on December 1, 1990. He was retired from the U.S. Department of Commerce. Hardy was a member of the Pickens First Baptist Church and the Sons of Confederate Veterans, and served on the Pickens County Airport Commission.

## XIII OCEAN ENGINEERING

**John S. Heffron**, NE '88, writes: "I was promoted to CDR and am currently a repair officer at the Naval Submarine Support Facility in Groton, Conn. News about MIT friends: Carol and Dave Johnson, NE '89, had a baby girl in January." . . . Lieutenant Commander **John G. Cooke V**, OCE '89, reports: "I am currently officer in charge of Submarine NR-1, the Navy's only nuclear-powered deep-diving oceanographic research submarine." . . . **Dionissios N. Assanis**, PhD '86, writes: "I was promoted to the rank of associate professor with tenure in the Department of Mechanical Engineering at the University of Illinois at Urbana-Champaign. I was also honored with the 1990 ASME/Pi Tau Sigma Gold Medal Award for outstanding achievement in mechanical engineering within 10 years after graduation." . . . **Bruce G. Collipp**, '52, marine engineering consultant, has been elected to the NAE. The Academy now has 1,580 members.

Captain **John Zabitsky**, SM '33, of Washington, D.C., died on January 29, 1991. Before WW II, he served on the battleship *Florida*, and as an engineering officer at Navy yards in Philadelphia and Charleston, S.C. During the war he did submarine repair work in the Southwest Pacific Theater, and later was head of the engineering

and repair department at the submarine base at New London, Conn. He was also supervisor of salvage at the Bureau of Ships in Washington, D.C. Zabitsky was production officer at the ship repair facility in Yokosuka, Japan, during the Korean War. He retired from the Navy in 1958 after having served four years in Camden, N.J. as superintendent of shipbuilding and naval inspector of ordinance for the New York Shipbuilding Corp. . . . **Clifford S. Gerde**, SM '44, of Aiken, S.C., died on January 19, 1991. His first career was as an officer in the Coast Guard. He taught in the Coast Guard Academy's engineering department from 1952-56. In 1956 he became the chief of design and naval engineering and was a registered professional engineer. He retired from the Coast Guard as a captain after 27 years of service. Gerde's second career spanned the years 1956 to 1978 at Purdue University where he taught and counseled engineering students. He was a professor of mechanical engineering and dean of the student engineering coop program. . . . **William J. Donovan**, SM '40, of Avon, Conn., died on February 4, 1991. He worked as an engineer for 50 years, 30 with his own firm of Donovan, Hammerick & Erlanson. For over five decades he sailed *Not by Bread Alone* and other boats on the Long Island Sound Racing Circuit.

## XIV ECONOMICS

**Richard K. Lyons**, PhD '87, sends word that he is an associate professor at Columbia Business School. . . . **Carlos Bachrach**, PhD '90, is living in Washington, D.C. . . . **Ann Friedlaender**, PhD '64, professor of economics and civil engineering and former dean of MIT's School of Humanities and Social Science, was elected the second public member of ISO's (Insurance Services Office, Inc.) board of directors. . . . **Frederick W. Gander, Jr.**, '65, has joined the Market Assessment Program at Charles River Associates, Inc., in Boston, as a senior associate. According to a CRA news release, "Gander has consulted to industry executives worldwide on financial, management, and technology issues. He has special expertise in metals marketing policies, plant operations, technology, and corporate financial structures." Prior to joining CRA, Gander was a senior member of the metals industry consulting practice at Arthur D. Little, Inc.

**Roger Kaufman**, PhD '78, has been promoted from associate professor to professor of economics at Smith College in Northampton, Mass. He has been teaching at Smith since 1983. . . . **J. Wade Miller**, PhD '48, was honored recently by the National Executive Service Corps for his volunteer management consulting services to Saint Peter's Roman Catholic Church in Yonkers, N.Y. Miller is a retired executive VP who worked at Organization Resources Counselors, Inc., management consultants. National Executive Service Corps, headquartered in New York City, provides management consulting services to non-profit organizations in many fields, including health care, education, religion, social services, and the arts.

**Avinash Dixit**, PhD '68, and **Barry Nalebuff**,



J.W. Miller

1895-1991

## Edward P. Brooks First Dean of Sloan

**E**dward Pennell Brooks, '17, the founding dean of the Sloan School of Management from 1951 to 1959, died of a heart attack on February 22 at his farm in Millboro Springs, Va. He was 95.

Dean Brooks was a vice-president and director of Sears, Roebuck and Co. in Chicago, Ill., when he was chosen by the late MIT President James R. Killian, Jr., '26, to head a new school of industrial management at the Institute. The school, which grew out of courses in administration and management offered at MIT since 1914, was established with a gift from the Alfred P. Sloan Foundation. It was named for its benefactor, the former General Motors head, in 1964.

Killian said at the time that the school's objective was "to capitalize on the broad resources of science and engineering at MIT by correlating them with the complex problems of industrial administration."

He said that Brooks brought to the post of dean "comprehensive industrial experience and a basic understanding of engineering as well as business methods," with "the capacity to translate that experience into an educational program." Equally important, he said, Brooks had "a basic understanding of the relationships of human beings within an organization, as well as the relationships and mutual obligations of business and society."

MIT's former president and chairman, Howard W. Johnson, who was recruited by Brooks to be associate dean of the Sloan School and then succeeded him as dean, said, "Penn Brooks, as MIT's first Dean of Management, set a requirement for quality and innovation in management education that has benefitted both the field and generations of MIT students. He was one of those larger-than-life personalities who brought excitement and energy to all of his activities. All of us who followed him will remember his unrelenting enthusiasm with a sense of affection and awe."

Brooks was a member of the MIT Corporation, the Institute's governing body, from 1941 to 1946. He retired in 1960 as dean emeritus and professor



emeritus, but continued to serve as a senior lecturer for several years. The Institute honored him in 1983 with the dedication of the Edward Pennell Brooks Center at MIT's Endicott House residence conference center in Dedham, Mass., and also estab-

lished an adjacent garden in memory of his late wife, Carol Wright Brooks, who died in 1971.

After graduating from MIT with a degree in business and engineering administration, Brooks served for two years as an officer in the Army's First Engineers, First Division. He was awarded the Distinguished Service Cross "for extraordinary heroism in action" during World War I.

Following the war, after early experience with several industrial companies, he joined Sears, Roebuck in 1927. He was retail merchandise manager, district manager, merchandise supervisor and, from 1939 to 1951, vice-president in charge of factories as well as a director of the company.

During these years he served industry in many capacities and was a director of more than 25 corporations, among them the Erie Railroad, American Optical Company, Sharon Steel, Armstrong Rubber, and Whirlpool Corp.

During World War II he served as consultant to various war-time activities, organized and chaired the Committee on Equipment and Materials of the Research and Development Board and, in 1945, was vice-deputy in charge of the American Mission to the Chinese War Production Board. He was awarded the Medal of Freedom and the Chinese Victory Medal.

After the war he continued to serve the federal government in various consultant capacities and, while at MIT, he led the first Advanced Management Program in India.

Brooks had been a director of the American Management Association and a Fellow of the American Academy of Arts and Sciences. He received an honorary doctor of science in commerce degree from Drexel Institute of Technology in 1958. He was active all his life in civic and cultural affairs in Chicago, Boston, and Virginia. □

'80, are the authors of *Thinking Strategically: The Competitive Edge in Business, Politics, and Everyday Life* (W.W. Norton, 1991). According to its jacket, the book "sets forth the significant findings of game theory as a series of basic strategic principles, abundantly illustrated with stories, of human interaction—in sports, politics, business, and personal life." Dixit is a professor of economics at Princeton University and Nalebuff is professor of economics and management at the Yale School of Organization and Management.

**Armund V. Feigenbaum**, PhD '51, is the author of *Total Quality Control*, (Third Edition, Revised; McGraw-Hill, 1991). Like its predecessors, this edition, revised in honor of the book's fortieth anniversary, details the importance of quality issues and the role they play in customer satisfaction.

**Theodore W. Zetterberg**, '52, of Pasadena, Calif., died on January 14, 1991. He worked as a freelance technical writer at U.S. Sprint and RCA Corp. in Southern California. Zetterberg, a member of many national organizations, was a charter member of the MIT Faculty Club and Phi Beta Epsilon fraternity at MIT. . . . Lieutenant Colonel **Churchill K. Wilcox**, '43, (USAF, retired) of Bedford, Mass., died on February 18, 1991. During his 27 years in the Air Force, Wilcox served primarily as a meteorologist. He then applied his knowledge of environmental science to research and teaching at Harvard and Tufts universities. He served in both World War II and the Korean War.

## XV MANAGEMENT

**Irwin M. Rubin**, PhD '66, writes from Honolulu: "I am president of Temenos, Inc., a human resource development consulting firm specializing in the process of organizational culture change. Our client base includes health care organizations in the U.S. and both public and private organizations in New Zealand. I'm also president of the Temenos Foundation, a not-for-profit organization committed to improving the quality of life through experiential learning." . . . From Richmond, Va., comes word about **Peter Barsotti**, SM '90: "Peter works as an accountant in a regional firm named Cherry, Bekaert, & Holland. However, since January, he has been in the Persian Gulf as a captain in the U.S. Army. He should be back home and working for CB&H either this summer or fall."

**Julie Farrar**, SM '90, is living in Acton, Mass. She and Brett D. Chapman were planning a May 4, 1991 wedding as of this writing.

**Akio Mitsufuji**, SM '89, sends word from Japan: "I was appointed a part-time lecturer on 'Factory Automation' at Tokyo Institute of Technology last fall. The discussion with young students was stimulating to me. I used some cases that I had learned at the MIT Sloan School. It was fun."

**Charles T. Harris III**, SM '80, is a partner at Goldman, Sachs, & Co. in New York City. . . . **Peter B. Blanton**, SM '81, writes: "I'd like to announce the birth of my second daughter, Jessica Amy, on December 10, 1990. She joins her older sister, Rebecca, 2 years old." . . . **Georges Culioli**, SM '88, sends word from Paris that he and his wife Dina are pleased to announce the birth of Alexa on November 28, 1990. . . . **Maxwell C. Coutts**, '39, reports: "I have just completed a year as president of the Kiwanis Club of North Toronto. While the Kiwanis Music Festival, supported by all clubs, is one of our major activities, we also support a grade 10 student with leadership talent, to attend HOBY Leadership Development programs." . . . Captain **Winfond G. (Jerry) Ellis**, SM '74, writes: "I was recently selected for promotion to the rank of rear admiral in the U.S. Navy." He is chief of staff of the U.S. Atlantic Fleet's Submarine Force. . . . In May 1990, **Takashi Hoshino**, SM '83, became a senior economist and manager at LTCB Institute of

Research in Tokyo.

**Robert Cohen, SM '84**, sends word: "My wife, Judith Magel, and I announce the birth of our first child, Noah Gabriel, on May 17, 1990. Noah arrived four weeks early, but everything went fine. I am the systems manager for the Renal Division of Baxter Healthcare Corp. in Deerfield, Ill. Judy works as a senior scientist in the area of technology assessment for the American Medical Association in Chicago." . . . **Amit Jyoti Sen, PhD '77**, writes: "In 1978 I joined the Indian Institute of Management in Calcutta as an assistant professor of behavioural sciences immediately after my return from the U.S. and I was promoted to professor in 1987. In 1985 I was made a member of the National Commission on Urbanisation set up by the government of India to examine the state of urbanization in the country and recommend basic policy towards urbanization. The commission submitted its report in 1988. My wife, Mandira, was with me in Cambridge throughout my stay at MIT, and worked in the Boston publishing offices of Little, Brown, & Co. and Houghton Mifflin. Upon our return she started her own publishing company in Calcutta specializing in children's books. She has subsequently diversified into publishing women's studies and is also partner of a firm that represents U.S. and British publishers in India. We have two children, a girl, Sucharita, aged 2, and a boy, Arka Jyoti, 6 months.

From Venice, Italy, **Arnaldo Camuffo, SM '90**, writes: "I am an assistant professor of human resources management in the Department of Business Economics and Management at the University of Venice. I joined the faculty after getting a DBA from the University of Venice. My latest publications (two books and a number of articles) concern the evolution of Italian textile-apparel firms and the strategic management of human resources in Italian small businesses. I got married just before graduation. Last December my wife, Francesca, gave birth to twins—Attilio and Laura." . . . **Susan W. Bailey, SM '87**, has become the town accountant of Rowley, Mass. She had been a senior consultant in the Management Consulting Division at Price Waterhouse in Boston. . . . **Sandra L. Helton, SM '77**, has changed positions at Corning. She moves from assistant treasurer of Corning Glass Works to VP and treasurer of Corning, Inc. . . . **Paul D. McKinnon, PhD '82**, who will continue as a principal in the firm, has been named a director of Harbridge House, Inc., located in Boston. . . . **Jeffrey L. Shames, SM '83**, has been promoted to senior executive VP of Massachusetts Financial Services Co. Prior to this, Shames was executive VP of the Boston-based firm.

**Thomas L. Magnanti**, the George Eastman Professor of Management Sciences at the Sloan School has been elected to the NAE. Magnanti is codirector of both the Operations Research Center and the Leaders for Manufacturing Program. He was cited for "leadership in operations research including fundamental contributions to optimal design of communication and transportation networks, and in education in manufacturing." The Academy now has 1,580 members, 103 of whom are MIT faculty. . . . **Robert Buchele, SM '66**, has been promoted from associate professor to professor of economics at Smith College in Northampton, Mass. Buchele joined the Smith faculty in 1977. . . . **Larry P. Yermack, SM '62**, has become president of Fairchild Space, the largest division of the Fairchild Space & Defense Corp. He was also elected as an officer of the corporation. According to a company news release, Yermack "is a consummate satellite executive whose extensive knowledge of programs, the customers, and competitive communities will be a definite asset for Fairchild Space." Most recently Yermack was program general manager, responsible for remote sensing and navigation programs for GE's Astro Space Division.

**John F. Fort, SM '66**, chair of Tyco Laboratories in Exeter, N.H., was interviewed in the February 1991 edition of *Business New Hampshire*. In the

short article, Fort talks about the company's expanding markets in Europe. For the fourth year, Tyco's stock has been ranked by *Fortune* among the top 20 industrial companies for total 10-year return to shareholders. . . . *Japanese Software Factories: A Challenge to U.S. Management* (Oxford University Press, 1991) is a newly published book by **Michael A. Cusumano**, the Mitsubishi Career Development Assistant Professor at the Sloan School. According to the dust cover, "Though Japan has successfully competed with U.S. companies in the manufacturing and marketing of computer hardware, it has been less successful in developing computer programs. This insightful book contains the first detailed analysis of how Japanese firms have tried to redress this imbalance by applying their skills in engineering and production management to software development." Cusumano lived for five years in Japan, studying at Tokyo University. . . . *Technology 2001: The Future of Computing and Communications* (MIT Press, 1991), edited by Derek Leebaert, contains a chapter by **William R. Johnson, SM '68**, entitled "Anything, Anytime, Anywhere: The Future of Networking."

### Sloan Fellows

**John P. Eberhard, SM '59**, writes: "In August 1989 I became the chair of the Department of Architecture at Carnegie Mellon University—my eighth career." . . . **Carl J. Willis, SM '88**, lives in Bridgewater, N.J., and was appointed manufacturing VP at AT&T General Business Systems last January. . . . **Richard W. Russell, SM '87**, is associate technical director for Plans and Programs at the Naval Underwater Systems Center in Newport, R.I. He had been the company's range development division head in the Test and Evaluation Department. . . . On March 1, 1991 **Philip A. Campbell, SM '70**, retired as vice chair and CFO of Bell Atlantic Management Services in Arlington, Va. . . . **William O. Albertini, SM '82**, is VP and CFO of the Bell Atlantic Corp. in Philadelphia. He had been president and CEO of Bell Atlantic Enterprises Corp., also in Philadelphia. . . . **Earnie Deavenport, SM '85**, president of Eastman Chemical Co. in Kingsport, Tenn., is a member of an all-star team of engineers named by *National Engineers Week*. Deavenport, one of the 20 engineers featured, served as a role model and joined 10,000 other engineers who volunteered to visit school classrooms during National Engineers Week held last February.

The Sun Company has a new president and CEO, **Robert H. Campbell, SM '78**. Previously Campbell had been executive VP of the Radner, Pa.-based company. . . . **J. Philip Samper, SM '73**, has resigned as president and CEO of Kinder-Care Learning Center, Inc., headquartered in Montgomery, Ala. . . . **Richard P. De La Chapelle, Jr., SM '74**, has retired as VP for Engineering and Manufacturing at GTE Products Corp. in Danvers, Mass. . . . **Glen D. Foss, SM '87**, has been named a director of Madison Paper Industries. He has headed the MPI department of employee relations since January 1989, after his return from an assignment with Madison Sales Co. in Stamford, Conn. Foss began working at MPI in 1978 as an industrial engineer. . . .



L.P. Yermack

**Stephen N. Gerson, SM '89**, has been appointed medical director of the Division of Behavioral Health Care at Peer Review Analysis, Inc., a multi-specialty and health care case management firm located in Malden, Mass. In this new position, he will be responsible for managed care review, consulting, and other operations associated with psychiatric case management. Gerson had worked for PRI for more than a year on a consulting basis and has also held positions at many of the medical centers and teaching institutions in the Boston area including McLean Hospital and New England Rehabilitation Hospital. He is currently an instructor in psychiatry at Harvard Medical School.

**Kay R. Whitmore, SM '75**, was presented with a Distinguished Alumnus award by the University of Utah Alumni Association. Whitmore is chair, president, and CEO of Eastman Kodak Co. in Rochester, N.Y. According to a university press release, "he has served the company in leadership positions since 1969 in Mexico, Latin America, Canada, and Rochester." . . . **Dale L. Compton, SM '75**, director of NASA's Ames Research Center, has been selected for the Silicon Valley Engineering Hall of Fame award. The award is presented annually by the Silicon Valley Engineering Council, which represents professional engineering societies and promotes the engineering profession and education in the valley.

Compton, a mechanical and aeronautical engineer, was cited as a pioneer in planetary atmosphere entry, in hypersonic aerodynamics and physics of high temperature gases, and in earth sciences. His management of research projects was described by the council as having produced important progress in U.S. aeronautics and space. . . . **James C. Foster, SM '85**, has been named to the newly created position of president and COO of Charles River Laboratories, a subsidiary of Bausch & Lomb. He will be responsible for all North American and European operations, including production, marketing, sales, strategic planning, and business development. Foster joined the company in 1976 as counsel and he has held several management positions since then. . . . **Thomas J. Kelly, SM '70**, VP for information resources management at the Grumman Corp., has been elected to the NAE. The Academy now has 1,580 members.

The Alumni/ae Association has been notified of the following deaths: **Orville E. Henning, '35**, of Erie, Pa., on February 29, 1990; and **Dean D. Kerr, SM '63**, of Salt Lake City, Utah, on June 14, 1989. There was no further information provided.

### Senior Executives

**J.F. Mathis, '63**, sends word from Summit, N.J.: "I am now heading (chair) of the N.J. State Commission on Science & Technology. I was also elected to the National Academy of Engineering in 1990." . . . **Brian T. Loton, '72**, has retired as CEO of Broken Hill Proprietary Co. in Melbourne, Australia. . . . **Heinz K. Hofmeister, '74**, has also retired as president of the Specialty Chemicals Group for Hoechst Celanese Corp. in Somerville, Mass. . . . **Martin E. Dandridge, '86**, has been promoted to president at Grumman Melbourne Systems. . . . **Joseph M. O'Hara, '90**, has been promoted to president of Bell Atlantic Systems, Inc., located in Princeton, N.J. . . . **Jim W. Hart, Jr., '82**, VP for public affairs of Panhandle Eastern Corp., was awarded the Outstanding Public Relations Practitioner award by the Texas Public Relations Association. According to a Panhandle Eastern news release, "Hart is the fourth person in the 37-year history of the association to receive this award as it is presented only when justified and supported by outstanding accomplishments and contributions to the public relations profession." Hart joined the company in March 1988, becoming VP for public affairs in January 1989. He is also a brigadier general in the U.S. Air Force Reserve and the reserve assistant to the director of public affairs in the Office of the Secretary of the Air Force at the Pentagon.

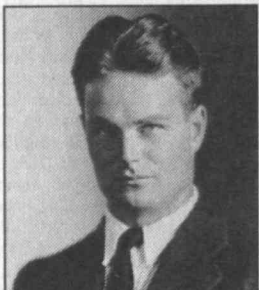
1903-1991

## Edward S. Taylor

**E**dward S. Taylor, '24, professor emeritus of flight propulsion and a leading figure in the development of both reciprocating and gas turbine engines, died on February 2 at his home in Lincoln, Mass. He was 88.

Taylor founded MIT's Gas Turbine Laboratory in 1946 and served as its director for 22 years. He was an international authority on aircraft gas turbine engines which make possible the pure jet, turbo-fan, and turbine-driven propeller engines that power today's high-performance aircraft. Taylor joined the faculty in Aeronautics and Astronautics in 1927 and retired in 1968, but remained active at the Gas Turbine Lab long after his retirement.

Taylor received the Sylvanus Albert Reed Award from the Institute of Aeronautical Science for his 1935 invention of a vibration absorber for reciprocating aircraft engines. Some have held that this invention alone led to the large radial engines that were employed so successfully in World War II and in large transport aircraft after the war.



In 1973 the American Institute of Aeronautics and Astronautics honored Taylor with its Robert H. Goddard Award for his "contributions to the advancement of the art and science of air-breathing propulsion over a period of 45 years as designer, inventor,

researcher, teacher, and leader of a major educational and research center of aircraft engine activity."

Taylor served as a member of the U.S. Air Force Scientific Advisory Board from 1955 to 1960, and as a consultant for many of the nation's leading firms in the aircraft propulsion and rocket propulsion fields.

Among his many publications, Taylor cowrote *The Internal Combustion Engine* with his brother, C. Fayette Taylor, professor emeritus of mechanical engineering at MIT and a former head of the Department of Aeronautics and Astronautics.

Until last year, Edward Taylor and his wife, Julia, had annually sailed their sloop from their summer home on Chappaquiddick Island to the Maine coast. He was also an accomplished silversmith and cabinetmaker. □

### Management of Technology Program

**Akio Mitsufuji**, SM '89, of Toyo Engineering Corp., has traveled to several countries in Europe and Southeast Asia on business this year. Most recently he visited Hungary where Suzuki Automobiles has decided to construct a passenger car plant near Budapest. Mitsufuji also received an appointment to lecture on "Factory Automation" at Tokyo Institute of Technology from which he graduated twenty years ago. He says that speaking directly to the young generation was a "spirit stirring" experience. . . . **Hajime Yamada**, SM '90, recently received a title change to senior manager of R&D Cooperation and Liaison Group at NTT R&D Information, Patent, and Licensing Center. His responsibilities range from technical contracts (including ILPs) to technical visits. Since negotiations with foreign organizations will turn him into a frequent flyer, he is looking forward to visiting the Boston area again.—Fay Wallstrom, Management of Technology Program, MIT Rm. E56-304, Cambridge, MA 02139

### XVI AERONAUTICS AND ASTRONAUTICS

**Frank H. Daurio**, SM '70, sends word from Malvern, Pa.: "I am in my seventh year with GE Aerospace Military & Data Systems Operation. I am a chief engineer for operations on a \$300-million-

plus program for NASA, the second TDRSS ground terminal (STGT). We are delivering a ground station complete with software, hardware, and trained operators to control NASA's TDRS spacecraft which relays commands, spacecraft telemetry, and user mission data between low earth orbiting vehicles and the ground from geosynch orbit. The STGT will become operational in early 1993 at White Sands, N.M." . . . **Robert W. Klein**, SM '80, writes: "I was appointed deputy engineering manager of vehicle systems on the F-14 program at Grumman Aircraft Systems in Bethpage, N.Y. My wife Clair and I now have a 1-year-old son, Robert Henry, and we live in Port Washington, N.Y."

**Kenneth B. Morton**, SM '74, has joined The Boston Co. as senior VP of The Boston Company Advisors, Inc., a wholly owned subsidiary that performs administrative and portfolio management functions for the company's mutual fund clients. Morton will also serve as manager of business planning and development within the company's Investor Services Group, where he will be responsible for business, strategic, and systems planning and systems development activities. Previously, Morton was a director at Coopers and Lybrand, where he spent eight years working with investment companies, insurance organizations, and banks. . . . **Earl M. Murman**, Course XVI department head and Project Athena director, has been elected to the NAE. He was cited for "contributions to computational fluid dynam-

ics, transonic and vortex flows, and the utilization of computers in engineering education." Joining Murman as a member of the NAE is **William Hewitt Phillips**, '39, distinguished research associate at NASA Langley. Murman brings to 103 the number of MIT faculty among the 1,580 elected NAE members.

The Alumni/ae Association has been notified that Captain **Frank M. Ralston**, SM '46, of Encinitas, Calif., died on January 28, 1990. There was no further information provided.

### XVII POLITICAL SCIENCE

**Evelyn Z. Brodtkin**, PhD '83, writes: "I was promoted to associate professor (tenured) at the University of Chicago's School of Social Service Administration. I am the author of *The False Promise of Administrative Reform: Implementing Quality Control in Welfare* (Temple University Press)." . . . **Dana G. Mead**, PhD '67, senior VP for White Papers Business at International Paper Co. in New York, has taken on additional responsibilities as a director for the company.

**Dan Rich**, PhD '72, professor of urban affairs and public policy at the University of Delaware, has been named dean of the College of Urban Affairs and Public Policy. Rich, who joined the Delaware faculty in 1970, serves as senior research associate with the Center for Energy and Urban Policy Research at the university, and has been acting dean and associate dean of the college. Recipient of an excellence-in-teaching award in 1986, Rich has been a visiting professor at the Centre for Planning at the University of Strathclyde in Glasgow, Scotland. He is a fellow of the AAAS, co-editor of *Energy Policy Studies*, and North American correspondent for the *British Regional Studies Association*.

### XVIII MATHEMATICS

**Leslie B. Lamport**, '60, a member of the research staff at Digital Equipment Corp.'s Systems Research Center in Palo Alto, Calif., was among a group of 77 engineers recently elected to membership in the NAE. He was cited for "contributions to the theory and practice of concurrent and fault-tolerant computing." His research has encompassed most areas of concurrent processing. After early work on array and vector processing, he is now concentrating on asynchronous concurrent systems. The U.S. membership of the Academy now numbers 1,580. . . . **Michael A. Arbib**, PhD '63, and **J. Alan Robinson**, are the editors of *Natural and Artificial Parallel Computation* (MIT Press, 1990). According to a blurb from the book jacket, "These eleven contributions by leaders in the fields of neuroscience, artificial intelligence, and cognitive science cover the phenomenon of parallelism in both natural and artificial systems, from the neural architecture of the human brain to the electronic architecture of parallel computers." Arbib is a professor of computer science, neurobiology, and physiology at the University of Southern California.



K.B. Morton



D. Rich

# Remembering a Rescue

By Debra Cash

It was 1940. She remembers the hand-operated sewing machine her mother brought to their rented room in the region of southern France not occupied by Nazis, and how she was paid for alterations with an onion or a bunch of carrots. She recalls the way her father, a journalist with one of France's 12 Russian-language newspapers, rode his bicycle from Paris to the little town of Pau in the Pyrenees mountains. She remembers the small deceptions of wartime: the trick of unlocking one side of a trunk so that the Nazis would believe it had already been searched and the way a pair of shoes had to be mailed one shoe at a time to keep both from being stolen.

Catherine Vakar was 13; her sister Anna 10. Under the rules of Vichy these French-born children of Russian emigrés were stateless persons with League of Nation passports. Yet that stateless position may have saved their lives. Because 50 years ago Catherine Vakar, now Catherine Vakar Chvany, was rescued from France by a mission of the American Unitarian Association. Today she is professor of Russian at MIT.

She calls her rescue "a fluke." She cites the kindness of strangers. Chvany was a beneficiary of the daring and commitment of a small group of activists led by Martha Sharp (now Cogan). The wife of a Unitarian minister in Wellesley, Mass., Martha Sharp had been involved with placing Czech refugees in England and the United States, arranging for the delivery of 12 tons of milk in the Bas Pyrenees when no relief supplies were getting through, and in 1940, had plans to bring 50 children out of France.

By that September, Chvany recalled recently in her Watertown home, the French had tightened restrictions and children with French passports were not free to leave. Around the same time, her father ran into Irina Okounieff Hay, an old school friend of Catherine's mother, who was then working as Mrs. Sharp's secretary. Hay told Vakar that the mother of two children in the original group had found another exit route for them and agreed to see if the Vakar children could be included in the transit.



MIT Professor Catherine Vakar Chvany, third from left, and her rescuer, Martha Sharp Cogan, sixth from right, at the 50th reunion of the escape from France. Six of the former refugees pictured are sisters. Inset: Catherine Vakar's passport photo at age 13.



In November, Catherine and Anna were part of a group of 27 children traveling through Spain and Marseilles with 10 adults. The youngest child was just 3, the oldest 16. They were issued identical beige berets, so that they could be located in a crowd.

"We were helped without feeling humiliated," she says today. "There was respect for the whole person. Even while poor Mrs. Sharp was worrying about dozens of suitcases, and arranging for places for us to stay when one boat in Lisbon left without us, they also took us to the Prado, to see the sights!"

The group disembarked from the S.S. *Excambion* on December 23, 1940, in New York City. The Vakar girls—who had no family or friends in the United States—were taken in by the family of Kerr Atkinson, members of the Sharps' Wellesley parish. They were reunited with their parents a year and a half later; unbeknownst to the girls, Atkinson had donated the cost of their parents' passage.

Catherine and Anna had become thoroughly Americanized. "Initially, I wasn't good at English; I was afraid to make mistakes, even though I was fluent in two other languages," Chvany says. "Today, I'm a great believer in

immersion. Bilingual education segregates people as disadvantaged. It would be far better to have everyone learn at least two languages and the poor kids—first-generation immigrants—could tutor the more 'advantaged' kids. We're all equipped to learn languages. It's not having expectations that makes people achieve less and lose self-confidence."

This past December, Chvany joined 10 other children rescued by the Unitarian mission for an emotional 50-year reunion. Martha Sharp Cogan—now 85—was named ABC television's "Person of the Week," and a fund in her name was created by the Unitarian Universalist Service Committee.

In a talk at Boston's Quincy Market, Professor Chvany noted "among my many debts to those who enabled us to build new lives is that my first impression of America [was] this example of noble service. The only way we can ever repay the generous, brave—one might even say reckless—families that took us in is by passing on our good fortune in individual ways, but in the same spirit of optimistic faith." □

The author is a frequent contributor to Technology Review.



**F.L. Bowman**

## XXII NUCLEAR ENGINEERING

**Hector Polenta**, NUE '84, writes: "Currently, I am a lieutenant commander in the Argentine Navy and I work in the Nuclear Technology Advisory Group to the navy's Chief of Staff. I am also trying to implement a couple of projects in Research Reactors of the CNEA, the Argentine Atomic Energy Commission: the first in neutron capture therapy, the second on innovative technology for instrumentation and control. I also hold the position of technical manager of PROFIL S.A., a local company dedicated to hi-tech filtration." Within Polenta's envelope we also found an enclosure from **Domingo Giorsetti**, SM '77. He writes: "I was promoted to rear admiral in the Argentine Navy in 1989 and since then have been VP of the Scientific & Technical Research Institute of the armed forces. I also hold the position of Nuclear Fuel Cycle Manager in CNEA, and head the Nuclear Technology Advisory Group to the navy's Chief of Staff. In 1990 I obtained a bachelor's degree in social psychology." . . . **Lawrence T. Papay**, ScD '69, has resigned as senior VP of Southern California Edison Co. in Rosemead, Calif.

**Frank L. "Skip" Bowman**, OCE '73, is among a small group of U.S. Navy captains selected for promotion to the rank of rear admiral in the next year. He was one of only 25 officers chosen for Flag rank out of 1,352 captains who were eligible. Most of Bowman's experience has been in submarines. In 1990, after spending two years in command of the USS *Holland*, Bowman was appointed director of submarine and nuclear power officer assignments for the Chief of Naval Personnel. . . . **James F. Jackson**, SM '62, deputy director of the Los Alamos National Laboratory, has been elected to the NAE. The Academy now has 1,580 members.

**David S. Carleton**, SM '75, of Phoenix, Ariz., died on February 8, 1991. He was employed as a nuclear engineer by the Arizona Nuclear Power Project in the Nuclear Fuel Management Group for five years. He had previously been employed by Northeast Utilities in Hartford, Conn., and Maine Yankee Atomic Power Co., in Wiscasset, Maine.

## TPP TECHNOLOGY AND POLICY PROGRAM

**Olivier De Botton**, SM '88, has joined the staff of Cartier International as a project manager . . . **Steven C. Anderson**, SM '87, is currently working at the German Agency for Technical Cooperation. He'll be headed for Pakistan and Nepal to participate in a planning seminar for small hydro systems. . . . **Hossein Mohsenzadeh**, SM '90, is now at the Bankers Trust International in London . . . **Jaime Maldonado**, SM '90, has a position with the National Planning Agency of Colombia as head of the Infrastructure Unit.—Rene Smith for Richard de Neufville, MIT, Rm. E40-252, Cambridge, MA 02139.

## Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

**Robert A. Warren**, '15; February 8, 1991; Weston, Mass.  
**Edward P. Brooks**, '17; February 22, 1991; Millboro, Va.  
**Roy J. Cook**, '17; February 23, 1991; Bradenton, Fla.  
**Leon Keach**, '17; March 5, 1991; Melrose Highlands, Mass.  
**Clinton L. Bond**, '20; February 22, 1991; East Dover, Vt.  
**Charles H. Klingler**, '20; November 30, 1988; Milwaukee, Wis.  
**Irwin B. Cassidy**, '22; May 29, 1989; Lakewood, N.J.  
**Charles B. Miller, Jr.**, '22; July 6, 1990; Charlotte, N.C.  
**Florence McCarthy Perry**, '23; February 7, 1991; Jacksonville, Fla.  
**John E. Silvasy**, '23; August 28, 1990; Youngstown, Ohio.  
**Marion E. Warner**, '23; July, 1989; Uncasville, Conn.  
**Lewis R. Collins**, '25; March 2, 1991; Portland, Maine.  
**Gilbert B. Fletcher, Jr.**, '25; October 31, 1988; Port Jefferson Sta., N.Y.  
**Harold V. Robichau**, '25; June 30, 1990; Beverly, Mass.  
**Russel D. Carlson**, '26; May 10, 1988; Van Nuys, Calif.  
**Waldemar I. Bendz**, '28; January 20, 1991; Cumberland Foreside, Maine.  
**Everett J. Delahanty**, '28; January 25, 1991.  
**Augustus R. Rogowski**, '28; March 13, 1991; Needham, Mass.  
**John K. Rouleau**, '28; February 4, 1991; Boynton Beach, Fla.  
**Charles H. Topping**, '28; January 13, 1991; Wawa, Pa.  
**Theodore Zavorski**, '28; January 29, 1991; Easthampton, Mass.  
**Otto Edward Wolff**, '29; March 9, 1991; Weston, Mass.  
**Elliott Earl**, '30; 1990; Manchester, Conn.  
**Louise Hall**, '30; December 16, 1990; Durham, N.C.  
**George E. Kloote**, '30; January 17, 1991; Holland, Mich.  
**Allen Prescott**, '30; 1983; Marco Island, Fla.  
**Theodore E. Waddell**, '30; February 3, 1991; Concord, N.H.  
**John H. Arnold**, '31; January 9, 1991; Allentown, Pa.  
**Arnold C. Childs**, '31; February 19, 1991; Sarasota, Fla.  
**Daniel M. Hopping**, '31; December 26, 1990; Bronxville, N.Y.  
**Giles W. Anderson**, '32; February 19, 1991; Devon, England  
**John Paul Breden**, '32; October 25, 1990; Orlando, Fla.  
**William A. Hall**, '32; February 2, 1991; Portsmouth, R.I.  
**Gordon Bunshaft**, '33; August 6, 1990; New York, N.Y.  
**John D. Rumsey**, '33; February 2, 1991; Bloomfield Hills, Mich.  
**Frank Vanucci**, '33; January 7, 1991; Newark, Ohio.  
**John Zabilsky**, '33; January 29, 1991; Washington, D.C.  
**Orville E. Henning**, '35; February 29, 1990; Erie, Pa.  
**Alfred R. Johnson**, '35; February 4, 1991; Reading, Mass.

**Michael G. Kelakos**, '35; February 27, 1991; South Yarmouth, Mass.  
**Patrick J. Mahoney**, '35; February 5, 1991; Natick, Mass.  
**Ruth M. Perkins**, '36; January 19, 1991; Sudbury, Mass.  
**Joseph S. Dunning**, '37; January 30, 1991; Los Angeles, Calif.  
**Harry W. Kohl**, '37; February 1, 1991; Camano Island, Wash.  
**C. Hubbard Little**, '38; October 25, 1990; Pepper Pike, Ohio.  
**John L. Cushnie**, '39; February 14, 1991; Mount Holly, N.J.  
**Chapin A. Harris**, '39; July 20, 1990; Plymouth, Mass.  
**William J. Donovan**, '40; February 4, 1991; Avon, Conn.  
**Arthur W. Knudsen**, '42; December 28, 1986; Calgary, Alberta, Canada.  
**Harlan K. Saylor**, '42; February 16, 1991; Washington, D.C.  
**Russell A. Thompson, Jr.**, '42; December 9, 1990; Baton Rouge, La.  
**Thaddeus J. Pieczonka**, '43; October 23, 1990; Lackawanna, N.Y.  
**Churchill K. Wilcox**, '43; February 18, 1991; Bedford, Mass.  
**Clifford S. Gerde**, '44; January 19, 1991.  
**Ben W. Moore**, '44; August 28, 1990; Bethlehem, Pa.  
**Frank M. Ralston**, '46; January 28, 1990; Encinitas, Calif.  
**John U. Weber**, '46; January 28, 1991; Fairhaven, N.J.  
**George L. LaPerche**, '47; January 30, 1991; N. Reading, Mass.  
**John K. Logan**, '47; October 5, 1989; Columbia, Md.  
**Robert B. Burlin**, '48; March 17, 1991; Melbourne, Fla.  
**Robert Delgado**, '48; February 27, 1991; Center Sandwich, N.H.  
**Robert J. McDonagh**, '48; February 17, 1991; Hingham, Mass.  
**William H. Revoir, Jr.**, '48; January 27, 1991; Providence, R.I.  
**Frank B. Ryan**, '48; January 22, 1991; Chatham, N.J.  
**Arnold H. Smith**, '48; March 1, 1991; King of Prussia, Pa.  
**Eric A. Robba**, '51; March 6, 1991; Mystic, Conn.  
**Michael E. Green**, '52; June 29, 1989; Marquette, Wis.  
**Paul L. Przybylke**, '52; February 1, 1991; Warrington, Penn.  
**Theodore W. Zeterberg**, '52; January 14, 1991; Pasadena, Calif.  
**Robert I. Gross**, '53; January 18, 1991; Roslyn Heights, N.Y.  
**George Okun**, '54; February 11, 1991; Larchmont, N.Y.  
**James R. Bartsch**, '55; March 1, 1991.  
**Thomas H. Regan**, '55; September 27, 1990; Fairport, N.Y.  
**Irvin H. Solt, Jr.**, '55; October 5, 1989; Los Altos Hill, Calif.  
**John A. Carbone**, '57; February 27, 1991.  
**Gilbert R. Speich**, '58; February 16, 1990; Naperville, Ill.  
**Dean D. Kerr**, '63; June 14, 1989; Salt Lake City, Utah.  
**Robert E. McPhail**, '67; January, 1991; N. Andover, Mass.  
**David S. Carleton**, '75; February 8, 1991; Phoenix, Ariz.  
**Augusto O. Rodriguez**, '76; May 28, 1986; San Jose, Costa Rica.  
**Allen K. Wells**, '82; February 19, 1991; Redmond, Wash.  
**Long-Chain Chen**, '88; February 4, 1991; Bowling Green, Ohio.

# A New Formula for the Color Purple

It has been over a year since I reviewed the criteria used to select solutions for publication. Let me do so now.

As responses to problems arrive, they are simply put together in neat piles, with no regard to their date of arrival or postmark. When it is time for me to write the column in which solutions are to appear, I first weed out erroneous and illegible responses. For difficult problems, this may be enough; the most publishable solution becomes obvious. Usually, however, many responses still remain. I next try to select a solution that supplies an appropriate amount of detail and that includes a minimal number of characters that are hard to set in type. A particularly elegant solution is, of course, preferred. I favor contributions from correspondents whose solutions have not previously appeared, as well as solutions that are neatly written or typed, since these produce fewer typesetting errors.

As noted by Steve Feldman, unlike usual "Puzzle Corner" practice, the three F/M problems were somewhat similar. I do try to give a mix of problem types each month but slipped up this time.

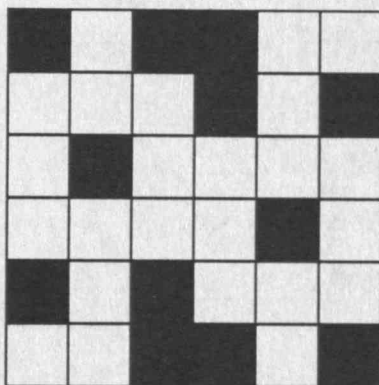
Robert High noticed that a variation on our 1990 APR 5 "pill problem" was submitted to the *American Mathematical Monthly* by Stanford University professors Knuth and McCarthy.

## PROBLEMS

**JUL 1.** Several readers noticed an unfortunate typo in APR 1: Both North and South were given the jack and six of hearts. Fortunately, reading the solution that Robert Bart supplied with the problem, I was able to deduce that South should have diamonds, not hearts. The corrected problem is South is on lead with spades trump and is to make 5 of the 6 tricks against best defense.

		North	
		♠ A J 4	
		♥ J 6 2	
		♦ —	
		♣ —	
West			East
♠ Q 8 7			♠ —
♥ —			♥ Q 8 7
♦ —			♦ Q 8 7
♣ Q 8 7			♣ —
		South	
		♠ K 9 6 5	
		♥ —	
		♦ J 6	
		♣ —	

**JUL 2.** The following crossword-like problem is from Nob. Yoshigahara:



The eight Down "words" are two- or three-digit perfect squares and the six Across words are two-, three-, or four-digit perfect squares with no perfect square used more than once. Unlike normal crossword puzzles, single-character words have no restrictions. For example, the lower left corner can be any digit (except that the two-digit Across word it begins must be a perfect square).

**JUL 3.** When Avi Ornstein was an artist, he found that he could get extra mileage by overlaying one ink with another. For example, if a yellow run was silk-screened over purple, brown would result. Nonetheless he proposes the following criptarithmic problem that directly contradicts his artistic experiences.

YELLOW + BROWN = PURPLE

## SPEED DEPARTMENT

A Bridge quickie from Doug Van Patter:

		North				South	
		♠ K J				♠ A Q 5	
		♥ A 10 7				♥ Q J	
		♦ A 9				♦ K Q J 10 8	
		♣ J 7 6 5 4 2				♣ A Q 8	

South is declarer at 6NT and West leads the spade 9, which Dummy wins with the jack. A low club is led and East discards the heart 8. Are 12 tricks possible?

## SOLUTIONS

**F/M 1.** Robert Rorschach has a novel solitaire game for which he would like a (presumably computer-generated) optimal strategy. The game involves 9 markers numbered 1 to 9, a table, and a standard pair of dice. Each game begins with the 9 markers on the table. A play of the game consists of throwing the dice and removing, if possible, a set of the markers whose total matches the total of the dice throw. When you throw a number that cannot be matched with the markers left on the table, the game is over and your score is the total of all the markers taken.

As an example, if you first rolled snake-eyes, your only choice in markers would be to take "2". A second roll of 8 would allow you to take either the "8" alone, or the "7" and the "1", or the "5" and the "3", or the "4" and the "3" and the "1". If you next rolled 2, you would not be able to make that total from the remaining markers. The game would be over and your total score would be 10.

As a player, you would like to maximize the expected value of the game. You need a strategy that specifies, for each set of markers that could remain on the table and for each of the possible rolls from 2 to 12, just which set of markers you should pick.

The solution below is from Robert Moeser. The proposer notes that a greedy strategy of favoring big markers does well (expected value 33.63) and Barry Margolin, a familiar name to USENET subscribers, notes a similarity to a '70s TV show called *High Rollers*.

The matter of F/M 1 recalled many happy hours playing a classic computer game called "Strike 9." This appeared in *Creative Computing*, Vol. 3, p.88 (1977) and also in the RCA Cosmac VIP Instruction Manual, 1977. The rules were somewhat more restrictive, allowing only a win (all markers taken) or a loss (some markers left).

In connection with that I had done some investigations suggesting that the likelihood of winning was about 1 in 14 games if play was good.

I modified these early programs to take account of the notion of a score. The game tree is quite small, allowing exhaustive enumerations of the expected values. The "how to play" list of 511 possible game positions (every subset of the 9 markers except empty) crossed with the 11 possible sums from the roll of two dice is also easy to produce. Monte Carlo simulation using that matrix as a guide produced very good agreement with the computed expected value of 33.84 after 1 million games played. This also verified a classic win in about 1 in 14.

This list of rules is quite cumbersome. Examination of the matrix failed to show (me!) any good way to perfectly condense the rules for memorization. However, of 5,621 entries (511 × 11), 1,581

*Continued on page MIT 20*



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: gottlieb@nyu.edu

# MIT LIFE INCOME FUNDS



## MR. ELISHA GRAY II

**HOME:** Benton Harbor, Michigan

**CAREER:** Mr. Gray, MG '28, began his career in Chicago as a store manager for Sears, Roebuck & Co., and moved on to become vice president of Cutler Shoe Company in 1933. In 1938, he joined the Nineteen Hundred Corporation, manufacturer of the washers and ironers marketed by Sears. In 1950, a year after Mr. Gray became its president, the company changed its name to the Whirlpool Corporation. He served as Whirlpool's chairman of the board from 1958 to 1971 and chairman of the finance committee from 1971 until he retired in 1977. Under his leadership, Whirlpool grew from a manufacturer of home laundry appliances to one of the nation's largest makers of home electric and electronic equipment, producing between 40,000 and 45,000 major appliances a day.

Mr. Gray has served as the chairman of the board of the Council of Better Business Bureaus, member of the board of governors of the American National Red Cross, and member of the MIT Corporation. He has long been an outspoken advocate of the social responsibility of people in business. He is pictured here at Whirlpool's Elisha Gray II Research and Engineering Center, named in his honor in 1971.

**GIFT OF CAPITAL:** The Elisha Gray II Fund (1928) in the Maclaurin Pooled Income Fund.

**QUOTE:** I believe that if you're doing well, you probably have been very lucky. You should share your good fortune.

**For more information** about gifts of capital, call Frank H. McGrory or D. Hugh Darden at MIT, (617) 253-3827.

Photo: Tersh Raybold, Whirlpool Corporation

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BY HERB BRODY

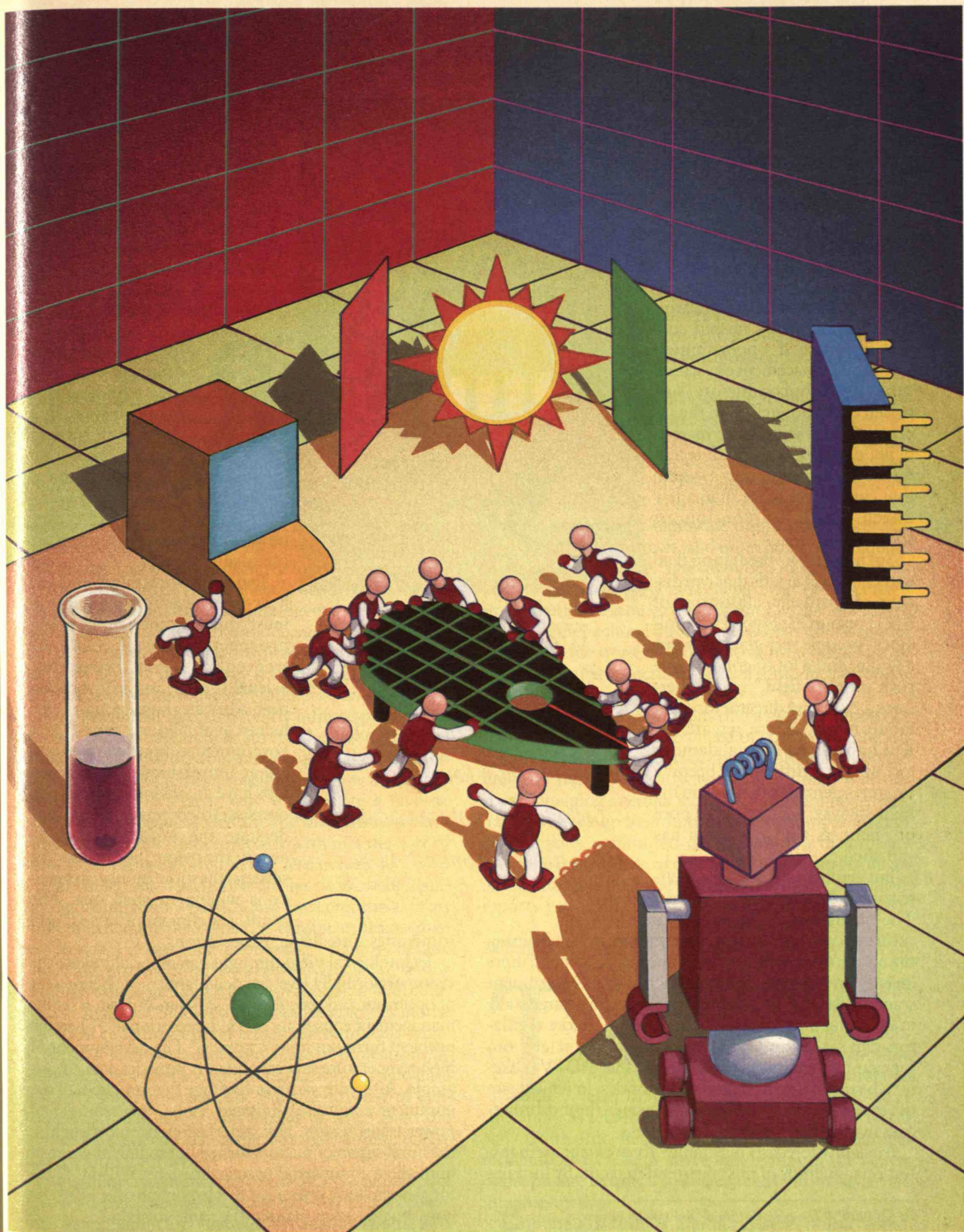
# Great Expectations

WHY TECHNOLOGY PREDICTIONS GO AWRY

**I**MAGINE a world where solar cells and nuclear fusion provide megawatts of pollution-free electricity, the average factory bristles with sophisticated robots, videotex terminals rival the TV set for attention in most households, automobiles run on batteries, and computers manipulate information in the form of light waves rather than electronic pulses.

*Technology  
seers  
misread their  
Ouija boards  
because  
they fail  
to heed  
basic  
principles.*

That's the world of today as envisioned by technological forecasters only a few years ago. In reality, of course, manufacturers have bought only a modest quantity of robots, videotex sputtered, solar electricity remains too expensive for all but a handful of applications, and electric cars and nuclear fusion seem, as always, to be at least a decade from practicality. Along the way, other technologies have sneaked into prominence while



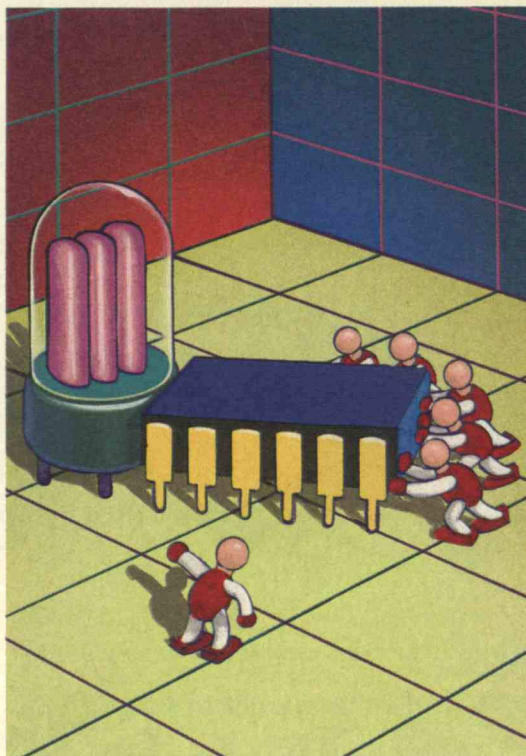
hardly registering a blip on prognosticator's early-warning radars.

No one can be blamed for not predicting the future with pinpoint accuracy. But ever since the first steamboats were derided as "Fulton's folly," experts' technology forecasts have amounted to a chronicle of wildly missed cues and squandered opportunities. The rapid replacement of vacuum tubes by semiconductors surprised even those close to the industry. Meanwhile, after years of hype, developers of voice recognition have yet to deliver a system that can handle more than a few dozen words of continuous speech.

Such errors in prediction lead to technological fads that can disrupt the orderly allocation of R&D resources. Hyped technologies "become very glamorous for a while, and a lot of good people rush into the field," says Robert Lucky, executive director for communications science research at Bell Labs. Even after a glamour technology's difficulties become clearer, scientists often stay in the field anyway. The result is a pool of scientists whose mission has vanished.

But erroneous forecasts can affect more than individual careers. The evaluation of a technology's future success plays an ever larger part in determining the nation's research agenda as universities depend more heavily on industry for research funding. Government standard-setting agencies have a particularly large stake in knowing how technology will move. Before regulators can set a standard for high-definition television, for example, they need to decide whether HDTV is likely to be piped into homes via fiber optics, in which case the video signal could be much richer than if broadcast over already crowded airwaves.

Are faulty forecasts inevitable? To an extent, perhaps. But certain kinds of mistakes tend to recur. By looking



*When the transistor was invented in the 1940s, its main use was thought to be in radios. Few saw its potential to replace vacuum tubes in computing.*

at these patterns, companies and policymakers may be able to judge more intelligently the course of today's embryonic technologies and allocate resources more productively.

### Misleading Missionaries

**R**osy predictions often originate with people who have a financial stake in a new technology. And since their bullish statements of technical potential are often misleadingly packaged as precise market forecasts, unwary businesses and investors often suffer.

To develop something new, you have to believe in it. Developers must convince others of the bright prospects as well. An entrepreneur needs financiers. Scientists in a large corporation need advocates high enough in the hierarchy to allocate funds. And government-supported researchers at universities and national labs have an obvious incentive to overstate their progress and understate the problems that lie ahead: the better the chances for success, the more money an agency is willing to shell out. The result is a climate of raised, and

sometimes unrealistic, expectations.

Technological breakthroughs can especially skew the vision of normally level-headed planners. "There's a lot of optimism and speculation," says Ian Wilson, a senior management consultant at SRI International. "Then the problem turns out to be complex." The development of high-temperature superconductors provides a recent example. After intense press coverage that proclaimed the imminent coming of levitated trains, intercontinental power transmission, and superfast electronic switches, the novel superconductors turned out to fall far short of immediate commercial practicality. Says Wilson: "History should have drummed this lesson into our heads by now, but we keep making the same mistake."

Similarly, researchers working on nuclear fusion have kept up a steady barrage of "breakthrough" reports since the mid-1970s. But despite bursts of progress, the magic break-even point—at which a reactor produces more energy than it consumes—remains elusive.

Market-forecasting firms feed the tendency to overestimate a technology's near-term promise. Companies such as Dataquest, Frost & Sullivan, and Business Communications regularly publish reports analyzing the business potential of existing and emerging technologies. Over the past decade, outfits like these have foretold billion-dollar markets for artificial intelligence, videotex, and virtually every other new technology that laboratories have reported.

Followers of these rosy visions have met a sorry fate. Numerous firms started up in the early 1980s, for example, to mine the supposedly large and growing market for industrial robots. Many received financing from venture capital firms hungry for short-term paybacks. But manufacturers either declined to modernize or opted for conventional automation instead, stranding the robotics startups. Artificial intelligence went through a similar cycle. Glowing pronouncements of AI's potential to reshape computing inspired a wave of new ventures. When the technology stalled getting out of the laboratory, the budding AI "industry" crashed.

One reason for the consistently inflated predictions is that market researchers survey the wrong people. Typically they ask the companies who make a technology how much of it they are selling and how much they expect to sell. It's clear why vendors are a favorite source: they are easy to identify, and their business plans often incorporate sales forecasts with just the sort of numerical estimates that excite researchers.

But such polls will almost always be skewed. Technology companies—particularly entrepreneurial firms in an emerging field—tend to exhibit an almost missionary zeal about their endeavors. "Vendors believe their own propaganda," says Steven Weissman, senior research editor at BIS CAP International, a Waltham, Mass., firm that follows the computer graphics industry. "You can almost never trust their numbers." Market researchers can create more realistic projections by studying a new technology's potential buyers, who have less of a stake in its success. But the universe of customers is much larger and harder to reach than the universe of sellers. Cost-conscious market researchers usually don't bother.

Weissman cites the advent of CD-ROMs, or compact disc read-only memories. Each CD-ROM disc, identical in appearance to audio CDs, can hold almost 700

megabytes—enough for 275,000 pages of text, or thousands of images. In the mid-1980s, market researchers proclaimed that CD-ROMs were inevitable companions to large numbers of personal computers. But computer users preferred magnetic hard disks, which, unlike CD-ROMs, are erasable and which retrieve data much more rapidly. The CD-ROM advantage in memory capacity has diminished greatly, too, as computer memories have grown from the 10 megabytes common in 1984 to 100 megabytes or more on some of today's machines.

The media have acted as willing accomplices in disseminating overblown forecasts. The business press, always on the lookout for the next hot technology trend, seizes on an inflated forecast as the basis for a news story. Analysts who go out on a limb with a forecast are cast as "the experts" and cited repeatedly.

Once printed in a reputable publication, forecasts take on a life of their own, and other publications quote them as authoritative. The myth of a huge robot market, for example, grew in large part out of statements by Prudential-Bache vice-president Laura Conigliaro, whose figures echoed throughout dozens of newspaper and magazine stories. Conigliaro's erroneous assumptions about manufacturers' needs took on the weight of truth in the retelling.

Such optimistic predictions find a receptive audience in business. They satisfy a need of companies and investors to identify potentially profitable technological breakthroughs. And those within a company who advocate pursuing a certain technology will pointedly seek data that back up their hunches. Even companies that have already committed themselves to a technology value the reassurance of an enthusiastic report from an independent firm. "The higher my numbers, the more reports I can sell," admits Weissman.

### Selling Today's Technology Short

**T**echnological forecasts tend to go astray partly because they underestimate the possibilities for advances in existing technology. "Theoretically, it's been possible for the past 25 years for computers to eliminate photographic film," says Alexander MacLachlan, senior vice-president for R&D at DuPont. But, he points out, continuing chemical refinements have kept silver-halide film in the center of the picture despite a strong challenge from electronic imaging media.

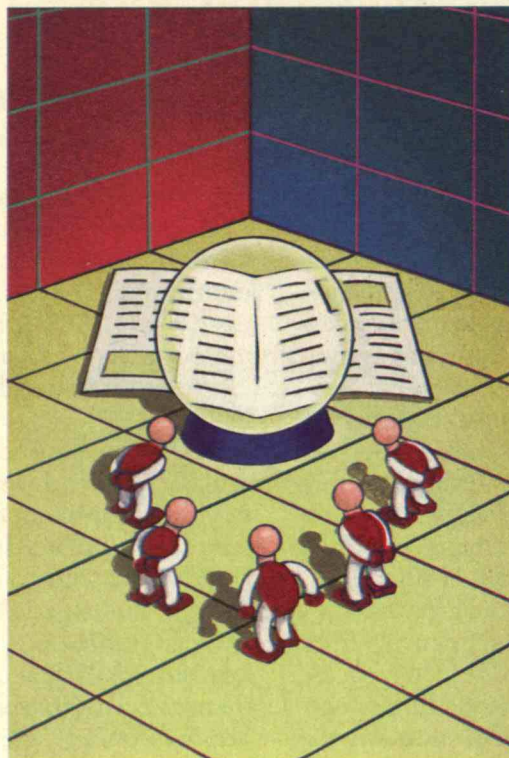
Chip manufacture is another case in point. Today

the production of virtually all integrated circuits involves optical lithography, in which light is projected through a mask onto a silicon wafer to form an intricate pattern of transistors and interconnecting wires. To pack more transistors on a chip—and hence increase its computational power or memory capacity—the lithography process must be able to create higher-resolution images.

During the 1970s, conventional wisdom held that optical lithography would soon run out of steam. "People believed there were fundamental reasons that optics would be unable to produce chips with feature dimensions smaller than about 1 micron," says Marc Brodsky, director of technical planning for IBM's Research Division. (A micron is a millionth of a meter.)

The optical process, it was widely thought, would give way to lithography using x-rays, which have much shorter wavelengths than light and so, in principle, can be focused more sharply. But instead of winding down, optical lithography has undergone continuous refinement. And while chips keep getting more densely packed, semiconductor makers have yet to abandon their tried and true techniques. Optical lithography is expected to carry chips down to feature dimensions of of a third or a quarter of a micron, says Brodsky.

An exotic class of electronic switches called Josephson junctions offer a classic case of an entrenched technology outpacing upstart challengers. IBM worked for 15 years on these devices, which use an ultrathin layer of superconducting material to achieve switching speeds far faster than the silicon transistors available during the 1970s. But the junctions' advantage slowly dissipated as silicon chips got faster and faster. "Nobody thought that the improvements in silicon would last so long," explains Brodsky. By the time IBM researchers had overcome the major problems of Josephson junctions, advances in silicon had erased the once compel-



*The business press turns  
inflated forecasts into news  
stories, and erroneous  
assumptions take on the  
weight of truth in the  
retelling.*

ling need for the the new technology.

Another electronic revolution continually postponed is the advent of gallium-arsenide chips. These high-speed devices are already widely used in microwave and opto-electronic equipment, as well as in some space and military systems, where gallium arsenide's ability to function despite exposure to nuclear radiation is prized. During the 1980s, bright prospects for gallium-arsenide chips spurred the formation of a miniature industry, largely with money from venture capital firms hoping to score big by backing the next Intel. But gallium-arsenide developers have so far failed to overtake swiftly improving silicon. "We've been hearing for 10 years that silicon is running out of gas," says Bell Labs' Lucky. "People forget that there are always an army of people working on improving an old technology and only a handful of people working on a new technology."

### Underestimating the Revolutions

**A**lthough consumer technology is probably the thorniest arena in which to prophesy, one enduring caveat is that consumers are unwilling to spend a lot of money on something only slightly superior to what they already have, especially if it's also less convenient. Quadraphonic sound, for example, forced audiophiles to rearrange their living rooms to provide seating in the small zone of optimal quadraphonic effect—and for all that, the music sounded only a little bit better. Small wonder the technology quickly disappeared.

In another misreading of consumers' appetites, high hopes abounded in the early 1980s among purveyors of home information services. One forecast in 1980 estimated that 5 percent of all U.S. households would be hooked into videotex by 1985. Consumers would supposedly relish the ability to go on-line with their computers and

shop, browse through encyclopedias, and read the latest news, weather, and stock market summaries.

Knight-Ridder spent \$60 million setting up a videotex service that never made money and was ultimately abandoned. Technology per se was not the problem—all the necessary computer and telecommunication power existed. Instead, videotex marketers badly misunderstood how people want to use their home computers. There are more efficient ways to do just about everything that videotex provides. Newspapers, printed encyclopedias, and shopping catalogs are superior for most people's purposes. Unlike businesses that deal with financial markets and other late-breaking news, consumers at home rarely demand up-to-the-minute information on anything.

While companies like RCA and Knight-Ridder have lost money by backing a loser, other businesses have made the opposite mistake: failing to pursue a winner. A common mistake is the tendency to evaluate emerging technologies as if they were direct replacements for something familiar. "New things are viewed in the clothing of the old," says James Utterback, a professor of engineering at MIT's Sloan School of Management. The difficulty with this, says Utterback, is that "old things are optimized for what they do already."

When the transistor came out of Bell Labs in the late 1940s, for example, its main use was thought to be as an electronic amplifier in radios. Few saw the potential of the new devices to replace vacuum tubes in digital computers, which were still in their infancy. At the time, many believed that these primitive computers were so potent that the world would never need more than a few dozen of them. Of course, it has been in computing that transistors—first as discrete components, later as devices on integrated circuit chips—have had their most profound impact.

Any truly revolutionary technology defies easy prediction. Until the late 1970s, for example, computer designers focused on building ever bigger and more powerful machines. Few foresaw what has turned out to be the technology's defining trend: the evolution toward personal machines using packaged software. "If you asked computer users in 1970 what they wanted, they'd have probably wished that Cobol [a programming language for mainframe computers] was a little easier to use," says Michael Rappa, a professor of management at the Sloan School. "The idea of a desktop computer with a graphical interface like that of the Macintosh would have seemed idiotic."

Indeed, virtually all the elements of today's personal computers existed in the mid-1970s. IBM reportedly

concluded, from its study of what computer users said they wanted, that PCs would appeal only to a small group of hobbyists. Xerox, too, forfeited its headstart in desktop computers because management thought the market was too small to be worth the company's while.

One reason for such problems is that the commercial success of a new technology often depends on factors outside the control of its developer. Videodisc players, for example, failed to take root as a popular consumer appliance despite enthusiastic predictions in the late 1970s. Although RCA invested heavily to market its SelectaVision videodisc system, which played prerecorded programs, sales never approached the mass-market RCA had counted on. In 1989 the company abandoned the product and took a \$175 million write-off.

Why did the videodisc fail while the videocassette recorder has enjoyed spectacular success? Certainly the VCR's ability to record programs for later viewing provided an obvious advantage. But millions of people who buy VCRs never figure out how to program the machines to record; they rent movies instead. In fact, the VCR owes much of its success to the advent of video stores. Just as Lotus 1-2-3 gave businesspeople a reason to buy a personal computer, the availability of a large number of movies at low cost justified the purchase of a VCR. RCA, by contrast, counted on videodisc owners to build up a library of discs that they would view repeatedly, even though most people want to watch a movie only once.

If retailers had had the idea of renting out videodiscs 10 years ago, disc players would probably now be much more prevalent in homes. After all, the players entered the market substantially cheaper than VCRs, which were then priced in the luxury range. And the picture from a videodisc is markedly superior to that from a tape.

### Coping with Uncertainty

Given that technology forecasting is a precarious science, some experts advise organizations not to pay much attention to predictions. "The illusion of knowing what's going to happen is worse than not knowing," contends MIT's Utterback. Rather than basing their strategy on flawed visions of the future, he says, managers and policymakers should make sure their organizations are agile enough to respond to technological changes as they occur.

Yet organizations with a financial interest in know-

ing the future of technology need not abandon prediction altogether, says SRI's Wilson. "Not everything is uncertain." He suggests a middle ground. Rather than predicting a single outcome, a forecaster should paint several scenarios of the future, each hinging on different assumptions. These scenarios, says Wilson, would suggest a "portfolio of technologies that will bound the envelope of uncertainty." Decision makers can speculate on the potential impact of each scenario on the organization's goals and on the technologies needed to reach those goals.

The fate of many energy technologies, for example, depends on the strength of the international environmental movement, particularly the effort to stem emissions of greenhouse gases. Nonfossil energy, notably solar and nuclear, will probably receive more urgent attention—and greater government funding—if the greenhouse warnings hold up to scrutiny. Organizations, says Wilson, should continually tune their planning as current events render scenarios more or less likely.

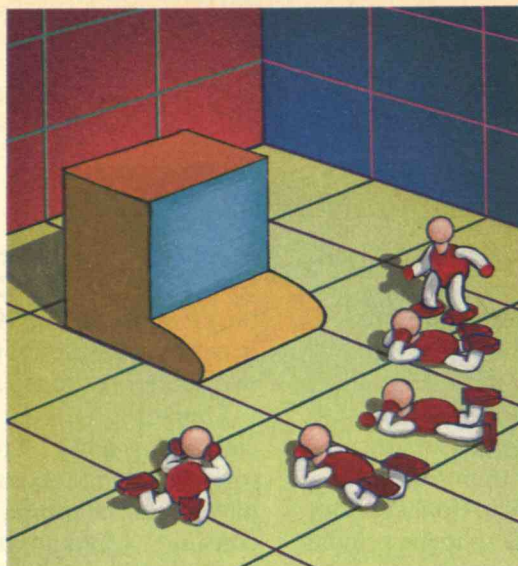
The uneven record of past predictions suggests a few other guidelines for avoiding costly and embarrassing mistakes:

- Watch developments in related fields. Ten years ago, laser printers cost \$10,000 or more. The technology for inexpensive laser printers came not from the printer industry but from Canon, which developed the laser units for photocopiers.

- Discount predictions based on information from vested interests. Investors, management, and the media repeatedly disregard this seemingly obvious advice. Interested parties include not only the companies that stand to make money from a technology but also scientists whose funding grows and wanes with the level of public excitement and who are also distant from the marketplace. "Researchers can be pretty naive about what's a good idea," says Phil Brodsky, Monsanto's director of corporate research.

- Expect existing technologies to continue improving. And don't expect people to abandon what they have for something new that is 10 percent better.

- Beware of predictions based on simple trend extrapolation. Telling the future by looking at the past assumes that conditions remain constant. This is like



*High hopes abounded among purveyors of home information services. But marketers badly misunderstood how people wanted to use their home computers.*

driving a car by looking in the rear-view mirror.

- Distinguish between technological forecasts and market predictions. It is one thing to say that new gallium-arsenide chips will be able to operate faster than silicon chips—that is a matter of physics and engineering. But to predict that the market for gallium-arsenide chips will reach a given level in a given year hinges on many hard-to-predict factors, such as the difficulty of handling the material in mass production, the demand for computers, and progress in competing technologies. People often deduce market impact from technology predictions without giving these other factors their due.

- Give innovation time to diffuse. Truly innovative technologies typically take 10 to 25 years to enter widespread use. This is true even for computer and telecommunications technologies that seem to have come out of nowhere: fax machines first appeared in the 1940s, and fiber

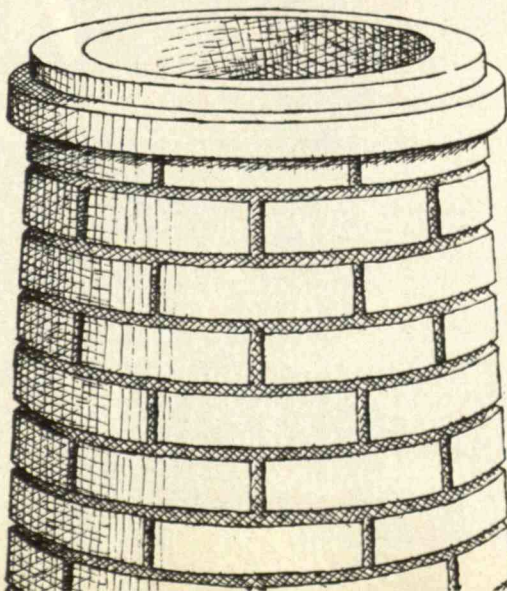
optics have been around since the 1960s.

- Pay attention to the infrastructure on which a technology's success depends. Lee De Forest invented the vacuum tube in 1906, but radio broadcasting did not begin until 1921; developing techniques to mass-produce the tubes reliably took 15 years. Any attempt today to figure when TVs will be hanging on living-room walls must begin with an analysis of the technology available for making flat-panel displays—slim imaging devices that weigh less and consume less power than the cathode-ray tubes used in conventional TVs and computer terminals.

There's certainly plenty of material for would-be technology seers to practice on. Neural-network computers, shirt-pocket telephones, hypermedia, computer-generated virtual realities, intelligent highway systems—all have their enthusiasts who tell of impending "revolutions." Which promises will be fulfilled and which broken?

Following the principles outlined here will help bring some order to the confusing torrent of technology predictions. But at bottom, prophesy is still a gamble. Bell Labs' Lucky likens technology development to the manipulations of a Ouija board. "Everybody's got their hands on it," he says, "but it always feels like somebody else is moving it." ■

A fuming smokestack is the perfect symbol of our national dilemma. On one hand, it means the jobs and products we need. On the other, it means pollution. 🍷 Some think having one without the other will take a miracle. We think it will take natural gas. 🍷 Because gas, the cleanest of all fossil fuels, can reduce emissions across the board. You name it—CO, CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, particulates—and natural gas combustion produces none or substantially less. 🍷 But gas is more than clean. It's extremely efficient as well. So even fewer pollutants are created since less fuel is expended to do a job. 🍷 Which also reduces costs. And that's another argument favoring gas. It makes the fight against pollution more affordable. 🍷 And, since nature blessed North America with vast stores of gas, it's a fight we can definitely win. With energy security and a better trade balance as a bonus. 🍷 Natural gas. It's not the only answer. Just the best one we have right now.



A photograph of a man with dark hair and a mustache, wearing a light-colored t-shirt and jeans, working on a lathe in a workshop. The photo is tilted and set against a green background. The man is looking towards the camera while operating the machine. The workshop environment is visible in the background, showing various tools and equipment.

*Many US, European, and Japanese manufacturers are setting up shop in less developed countries to escape environmental and worker-safety regulations.*

# Deadly Migration

## HAZARDOUS INDUSTRIES' FLIGHT TO THE THIRD WORLD



1988, a California manufacturer of epoxy coating materials decided that it could no longer afford to make its products in the United States. The cost of complying with new emission standards for the solvents the products contained would simply have been too high. Yet the company learned that if it set up shop in Mexico, it not only could use the same solvents but could dump waste solvents at no cost into the arroyo behind the plant.

It's no secret that the low cost of manufacturing in Third World and newly industrialized countries has prompted thousands of First World corporations and investment groups to set up manufacturing operations there. The biggest lure, of course, is cheap labor—factory wages in countries such as Thailand, Bangladesh, Ghana, Guatemala, and Bolivia are often as low as 5 percent of those in industrialized countries. Companies also manufacture abroad to be closer to foreign markets and to overcome trade barriers. In return, the host countries reap significant benefits. According to the U.N. Environment Programme, foreign companies and investors have provided 60 percent of all industrial investment in developing countries over the past decade. For many nations, such investment is the primary source of new jobs.

*No safety guards, no gloves, no goggles, no protective clothing. To the foreign investors who bought into this Bombay machine shop, a lack of attention to worker safety translates into lower manufacturing costs than in their own countries—and thus higher profit margins.*

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BY JOSEPH LADOU

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But the industrial migration has a perverse side, the extent of which the California epoxy case can barely hint at. As developed nations enact laws promoting environmental and occupational safety, more and more manufacturers are moving their hazardous and polluting operations to less developed countries, most of which have either no environmental and worker-safety regulations or little power to enforce those that are on the books. Hazardous industries have migrated to many parts of Africa, Asia, and Eastern Europe. Japan, for example, with its limited land and dense population, has a pressing need to export manufacturing industries such as electronics, chemical production, and metal refining. And many European nations have exported hazardous industries such as textiles, petrochemicals, mining, and smelting.

There is an ironic twist to the problem. Countries that spend little on things like sewage systems, water treatment plants, and enforcement of environmental and occupational safety can offer tax rates dramatically lower than those in the industrialized world. Foreign-based manufacturers take the bait and move in, polluting waterways and endangering workers. Yet the host government can't afford remedies because of the low tax rate.

Pollution and working conditions are so bad that, in effect, the Industrial Revolution is taking place all over again, but with much larger populations of workers and in many more countries. And many of the resulting deaths and injuries are taking place with the complicity of First World companies.

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## The Faces of Exploitation

The practice of using less developed nations as a dumping ground for untreated factory waste is but one of many forms the export of industrial hazards can take. Industries whose markets in developed countries are shrinking because of environmental concerns are vigorously promoting their products in the less health-conscious Third World. DDT is a compelling example. Its worldwide production, led by U.S. and European companies, is at record levels, even though it has been illegal to produce or use the pesticide in the United States and Europe since the 1970s.

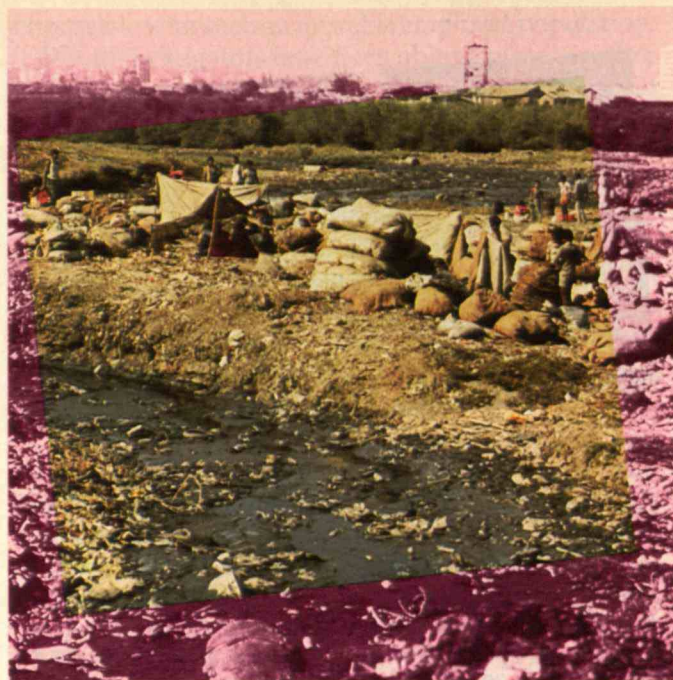
Asbestos is another distressing example. To stimulate the development of companies that will produce asbestos products, Canada's government sends free samples of the material to a number of poorer countries, where many workers and communities are still unaware of the mineral's dangers. (Bangladesh received 790 tons, worth \$600,000, in 1984.) Partly as a result of such promotion, Canadian asbestos exports to South Korea increased from 5,000 tons in 1980 to 44,000 tons in 1989. Exports to Pakistan climbed from 300 tons to 6,000 tons in the same period. Canada now exports close to half its asbestos to the Third World.

The First World also exports entire industries—including most lead smelting, refining, and product manufacture—that present occupational hazards. In developed nations, companies using processes that involve lead are required to take costly precautions to protect workers. U.S. lead workers must receive special training, have proper work clothes and changing facilities, and go on paid leave if tests reveal high lead levels in the blood. But in the lax regulatory climate of Malaysia, most lead-acid battery workers—at both foreign- and locally owned plants—have lead levels three times

*Far left: An Indian worker is allowed to spend five minutes on the roof of his foreign-backed factory to overcome intoxication from using solvents without protection or ventilation.*

*Left: At a Japanese electronics plant in Jakarta, an Indonesian worker is under the impression that a cloth mask will protect him from toxic fumes.*

*Right: This area of Bombay, where bazardous industrial waste mixes with garbage before flowing into the harbor, typifies the lax environmental standards that draw foreign manufacturers to the Third World. The dark streak is an anaerobic stream oozing past the makeshift housing of Indians who forage for recyclables. Fishing boats often have to sail at least 10 miles out to find live fish in the Indian Ocean.*



as high as allowed in U.S. workers. And lead plants exported to India continue operating even though 10 percent of the workers have lead poisoning.

Even a migrating industry that doesn't involve toxic materials can be hazardous, because First World corporations often apply a double standard to worker safety. At home, they might comply rigorously with health and safety regulations. Abroad, the same companies let safety standards plummet to the levels prevailing in the less developed host country.

Those levels are miserably low. Worker fatality rates are at least twice as high in industrializing countries, and workplace injuries occur with a frequency not seen in the developed nations since the early years of the Industrial Revolution. Workers in poor countries—usually with limited education, skill, and training—tend to labor in small, crowded factories with old, unsafe machinery, dangerous noise levels, and unsound buildings. Protective gear is seldom available. The companies also tend to be geographically scattered and inaccessible to health and safety inspectors.

On learning of such conditions in India or Malaysia, we in the First World may wince but may also be tempted to put them out of mind—to regard them as a Third World problem from which we are comfortably remote. Yet Americans need look no farther than their own southern border to find some of the worst instances of migrating industries' disregard for human health and environmental safety. Many of the factories that U.S. and other foreign interests operate in northern Mexico freely pollute the water, the air, and the ground and subject workers to conditions nothing short of Dickensian.

## The Siesta of Reason

In 1965, Mexico sought to overcome chronic unemployment through the Border Industrialization Program, designed to lure foreign manufacturing business—mainly from the United States—into Mexican border states. The country's government hoped that foreign capital would flow into the economy along with modern production methods that would help create a skilled workforce.

Under the program, manufacturers send raw materials and equipment to Mexico. If they agree to take back the finished products, they need pay taxes only on the value added in Mexico instead of on the value of the entire product. Another big draw is that factory wages average about \$5.40 per nine-hour day, less than in Korea, Taiwan, Hong Kong, and other countries long favored for off-shore manufacturing. For U.S. investors, the cost of transporting goods and materials to and from northern Mexico is lower as well.

Today, nearly 1,800 factories operate under this program in northern Mexico, employing about half a million workers. The plants, known as "maquiladoras," extend from Tijuana in the west to Matamoros on the Gulf of Mexico. Their owners include some of the largest U.S. corporations: IBM, General Electric, Motorola, Ford, Chrysler, General Motors, RCA, United Technologies, ITT, Eastman Kodak, and Zenith. Japan's Sony, Matsushita, Hitachi, Yazaki, and TDK also run maquiladoras, as do numerous European companies.

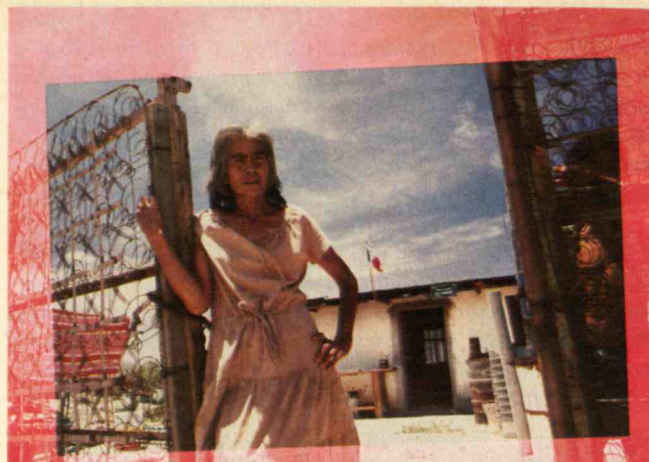
Most maquiladoras are small plants with fewer than 100 workers. In the program's early years, they were largely clothing manufacturers and hand assembly operations, employing mostly women. Today maquiladoras manufacture or assemble a wide range of products, from automobile parts to high-technology electronic components. Men now account for close to 40 percent of the workforce.

No one disputes that the main goal of the Border Industrialization Program has been met. The estimated \$3 billion in foreign exchange earnings that maquiladoras pump into the Mexican economy each year now exceeds revenues from tourism and is second only to Mexico's oil and gas exports. Virtually all the new manufacturing jobs created in Mexico in the past



*Left: A slum in Nogales houses Mexicans who have flocked north to find jobs in "maquiladoras"—plants owned by U.S. and other foreign companies. The city's population has quadrupled in 20 years.*

*Right: Like most of the workers in maquiladoras, Marisa Rodriguez of Juarez makes just over \$5 a day. She has no running water or electricity in her home and must provide for her nephew.*



Indeed, the very terms of the Border Industrialization Program seem to encourage recklessness. Many foreign companies or investment groups set up maquiladoras through the Mexican government's "shelter program," whereby the parent company—typically known only to the government—maintains control of production and a Mexican company forms to act as co-manager. This shelter firm recruits, trains, and pays all the Mexicans in the workforce. It also manages relationships with the local community and with the Mexican government. In short, foreigners run the business while their Mexican partners see to the social tasks. Because it is a Mexican corporation, the shelter operator shields the foreign company from liability in case Mexico ever cracks down on violators.

Consequently, the foreign operators have little incentive to make sure the 20 million tons of hazardous waste that maquiladoras generate each year is properly disposed of. No data are available on how much of this waste is deposited in rivers and streams, the air, or the ground, but the volumes are enormous. For example, the New River flows northward from Baja California into California contaminated by industrial wastes such as chloroform, benzene, toluene, xylene, and PCBs, and by agricultural runoff that contains various pesticides, including DDT. The river also carries more than 20 million gallons of raw sewage each day.

California has evaluated numerous alternatives to protect community health and Imperial Valley agriculture. The cheapest solution is to provide the Mexican city of Mexicali with a wastewater collection and treatment system, following the approach proposed for Tijuana sewage. The U.S. Environmental Protection Agency may eventually have to take similar action for all the major cities and towns along the U.S.-Mexico border. In that event, the U.S. taxpayer would ultimately pay for the reduced cost to industry of manufacturing in Mexico.

Mexico's lax monitoring of industrial practices encourages dumping of hazardous waste. Under Mexican law, toxic materials brought in by plants for use in manufacturing—such as paints, cleaning solvents, oils, and acids—must be returned to the country of ori-

decade—and a fifth of the country's manufacturing jobs overall—resulted from the rapid growth of the maquiladoras.

Yet these benefits have come at a high cost. The Border Industrialization Program has created serious social and environmental problems in both countries, but especially in Mexico. The prospect of employment in maquiladoras has caused the populations of border towns and cities to swell. Since 1970, for example, Nogales (south of Tucson) has grown fourfold to 250,000, and Juarez (across the Rio Grande from El Paso) has grown from 250,000 to 1.5 million.

Overcrowding strains these municipalities beyond their limits. Tens of thousands of workers subsist in cardboard huts in squatters' camps without heat or electricity, and sewage is dumped into the arroyos, through which it flows to the nearest river or estuary. At least 10 million gallons of raw sewage from Mexico flows into the Tijuana River every day, polluting San Diego's beaches. The Mexican government is so hard pressed to deal with the problem that the U.S. government, the state of California, and the city of San Diego have agreed to pay most of the \$192 million cost of a treatment plant on the border.

But maquiladoras do more than just overburden sewers. Many owners and managers—especially of small maquiladoras engaged in metal working, plating, printing, tanning, and dyeing—readily admit that they moved their operations to Mexico partly because hazardous processes are unwelcome in the United States and other developed countries, and that Mexico is not creating any serious obstacle to their activities. As one owner of a furniture factory explained to me, "I can find lots of Mexican workers in the United States. What I can't find here in Tijuana is the government looking over my shoulder."

gin or recycled in Mexico. But according to the Texas Water Commission, only about 60 percent of these waste materials leave Mexico. The other 40 percent—much of it toxic, the commission reports—is disposed of illegally in Mexico's sewers, drainage systems, and landfills. When waste is returned to the United States, it is often transported in improperly packaged and labeled containers.

## Dirty Work

Just as the amount of illegally dumped waste is difficult to pin down, so too is hard information on working conditions in maquiladoras. Not only do U.S. and Mexican maquiladora managers deny investigators access to their plants and their workers, but the Mexican government discourages inquiries and health studies. What's more, the U.S. Department of Commerce refuses to share its list of companies participating in the maquiladora program so as not to discourage them from complying with reporting procedures.

High worker turnover rates—6 to 15 percent per month in the states of Chihuahua, Sonora, and Baja California—also make it difficult to survey health effects in maquiladoras. Controlled studies are almost

*Left: Because of Mexico's weak enforcement of environmental laws, maquiladoras can dump chemical waste directly into waterways.*

*Right: Maquiladora workers in a foundry that makes auto engine parts labor without proper protective clothing or ventilation.*

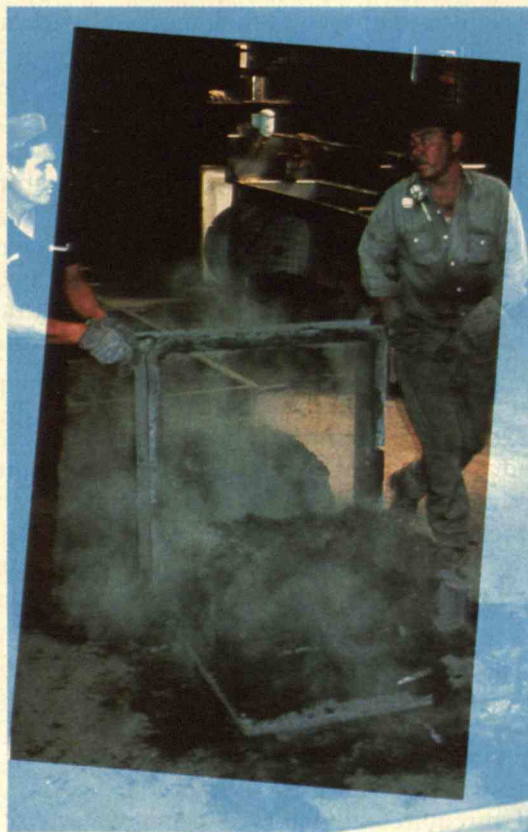
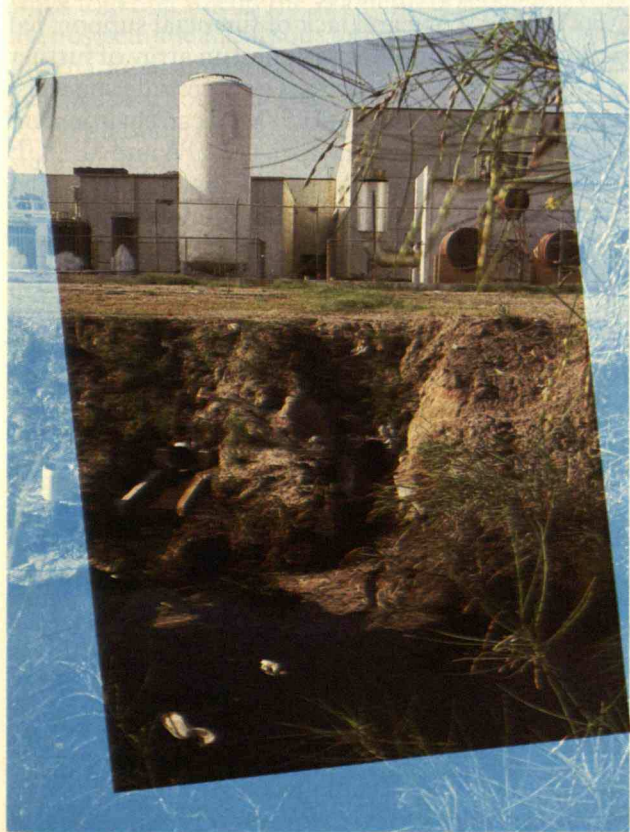
impossible with such an unstable employee population.

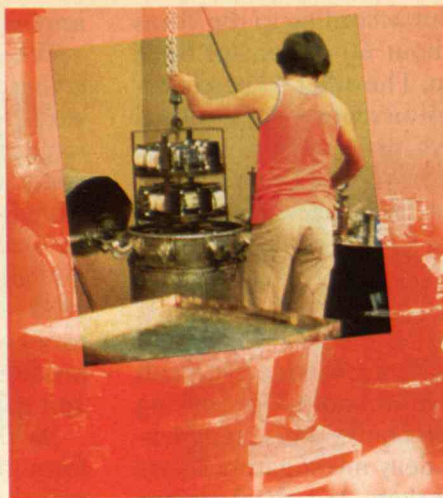
What investigators have been able to piece together is that while working conditions in the maquiladoras vary greatly, they are in most cases far inferior to those required in developed countries. Many plants are inadequately ventilated and lighted. Accidents resulting from inattention to safety procedures and the absence of safety equipment are frequent. Nogales maquiladoras reported more than 2,000 accidents in 1989—three times the accident rate of comparable factories on the U.S. side of the border. Sanitation is poor, production quotas are high, noise is often excessive, and machinery is often unsafe.

Workers also receive few rest periods and must perform long hours of microscopic assembly work. And even though many workers regularly handle hazardous materials—especially organic solvents—protective clothing, gloves, and other safeguards routinely required of U.S. industry are rare. To make matters worse, the workers lack safety instruction on the hazardous materials they are using—again a U.S. requirement.

Some plants even allow workers to take home empty contaminated steel drums that once contained hazardous chemicals such as pesticides, solvents, acids, and alkalies. Thousands of these containers are used to store water for domestic purposes throughout the industrial regions of Mexico.

Because of a dearth of studies, the amount of harm caused by such exposure is essentially unknown. But the case of Matamoros, the town where the former U.S.





*Left: The picture is not out of focus. It's just that the air breathed by these maquiladora workers—including a small child—is filled with pesticide dust.*

*Right: Perched on wooden pallets and surrounded by makeshift gear, a worker in an electronics maquiladora dips transformers in sealant. The crude attempt to draw off vapors (left side of photo) is not adequate for industrial hygiene.*

company Mallory Capacitors operated a maquiladora for many years, raises alarming possibilities. The Matamoros School of Special Education has identified 20 retarded children whose mothers were pregnant while employed by Mallory and required to work with PCBs, highly toxic chemicals used in the company's products. PCBs were banned in the United States in 1977 because of their toxicity.

The Matamoros exposures occurred for full workdays over many months. The women often had to reach into deep vats of PCBs with no protection other than rubber gloves. Many of the workers developed the chloracne rash these chemicals typically cause. Recent medical studies in Taiwan and Japan of pregnant women exposed to PCBs reveal the same sort of retardation as in the children of Matamoros. It is very likely that many more children damaged by their mothers' work at Mallory live in other Mexican towns that health researchers have not yet studied. And Matamoros may not be the only town in Mexico where PCBs have caused retardation.

Why does Mexico allow these environmental and occupational abuses to continue? One reason is a lack of resources to combat the problem. SEDUE (Secretariat of Urban Development and Ecology), Mexico's environmental oversight agency, faces financial constraints that limit its ability to regulate the maquiladora industry.

But political constraints play a role as well. The Mexican government enthusiastically supports the maquiladora program. Should SEDUE become too aggressive in its efforts, the government might withdraw the meager environmental funds the agency does receive. Municipal governments also operate from a precarious position. If they complain about hazardous waste dumping or unsafe working conditions—or if they press for taxes to support better sewage treatment facilities, schools, and medical care—the owners might move the plants to other cities or even other countries.

Despite these problems, Mexico has made some progress in environmental regulation. In May 1989, SEDUE required all plants to obtain water discharge

permits indicating their compliance with Mexico's rather liberal laws on toxic waste treatment. They may then dump the treated water into the sewer system. Any plant violating this requirement can be fined up to \$70,000, and those responsible face a prison sentence of six years. But like most environmental laws in developing countries, this threat is made by an agency that lacks the full backing of its government and the resources to carry out its mission. So far, this effort has produced few results, although a number of companies are now consulting with industrial hygienists and safety engineers to ensure that they will not be fined.

The U.S. government, too, is inching toward cleaning up the border—likewise with few concrete signs of progress. The federal Rio Grande Pollution Correction Act of 1988 aimed at dealing with that river's problems. But its limited scope and lack of financial support led to widespread disappointment and an array of further legislative attempts. Congress is now considering legislation to set up a permanent U.S.-Mexican environmental health commission, in which the EPA and SEDUE would work jointly to evaluate the maquiladoras and explore ways of preventing or punishing environmental abuse along the border.

Unfortunately, none of these proposals addresses the fundamental flaws of the maquiladora program, such as its failure to raise enough taxes to improve infrastructure. Given both governments' acceptance of the present system, no law that would attack the problems at their roots has any serious likelihood of enactment in the near future.

### **An International Approach**

The slowness of the United States in dealing with abuses by the maquiladoras is typical of the way First World nations have responded to the problems caused by the export of hazardous industries. Like the EPA, which devotes only about a tenth of a percent of its budget to its Office of International Affairs, the environmental agencies of other wealthy countries are just beginning to develop concern for the consequences of



*By law, a maquiladora must return empty toxic-chemical containers to the United States. But slum dwellers have found a use for many of them: storing water for drinking.*

industry's actions abroad. Nevertheless, it is the exporting nations that need to take the initiative.

The host countries, hungry for jobs and foreign capital, cannot be expected to make the first moves to end unsafe and polluting practices—and they often resent outside pressure to do so. Poorer nations take the position that only after they have attained the standard of living that rich countries enjoy will they adopt the restrictive environmental policies of the First World. What's more, these countries generally lack large, well-funded environmental groups like those in Europe and the United States. Popular support for actions that may impede the growth of the job market and a rise in living standards is virtually nonexistent.

Thus the world's industrialized nations will have to work together to end the shameful practice of exporting obsolete and hazardous technologies and industries. International agreements must replace the perverse incentives that threaten the world's environment.

International environmental organizations could help stem many of these problems. The U.N. Environment Programme, for example, has been working with a number of Third World countries to introduce siting requirements for hazardous industries. UNEP is also developing information centers on hazardous materials. The U.N. World Health Organization (WHO) and International Labour Office (ILO) provide some guidance to developing countries on occupational health and safety. But the combined annual budgets of these agencies is only about \$3 million, severely hampering their ability to fund environmental research and provide worker education and health inspections. And WHO and ILO have confined their activities mainly to larger employers, while the vast majority of work-sites in developing countries are small.

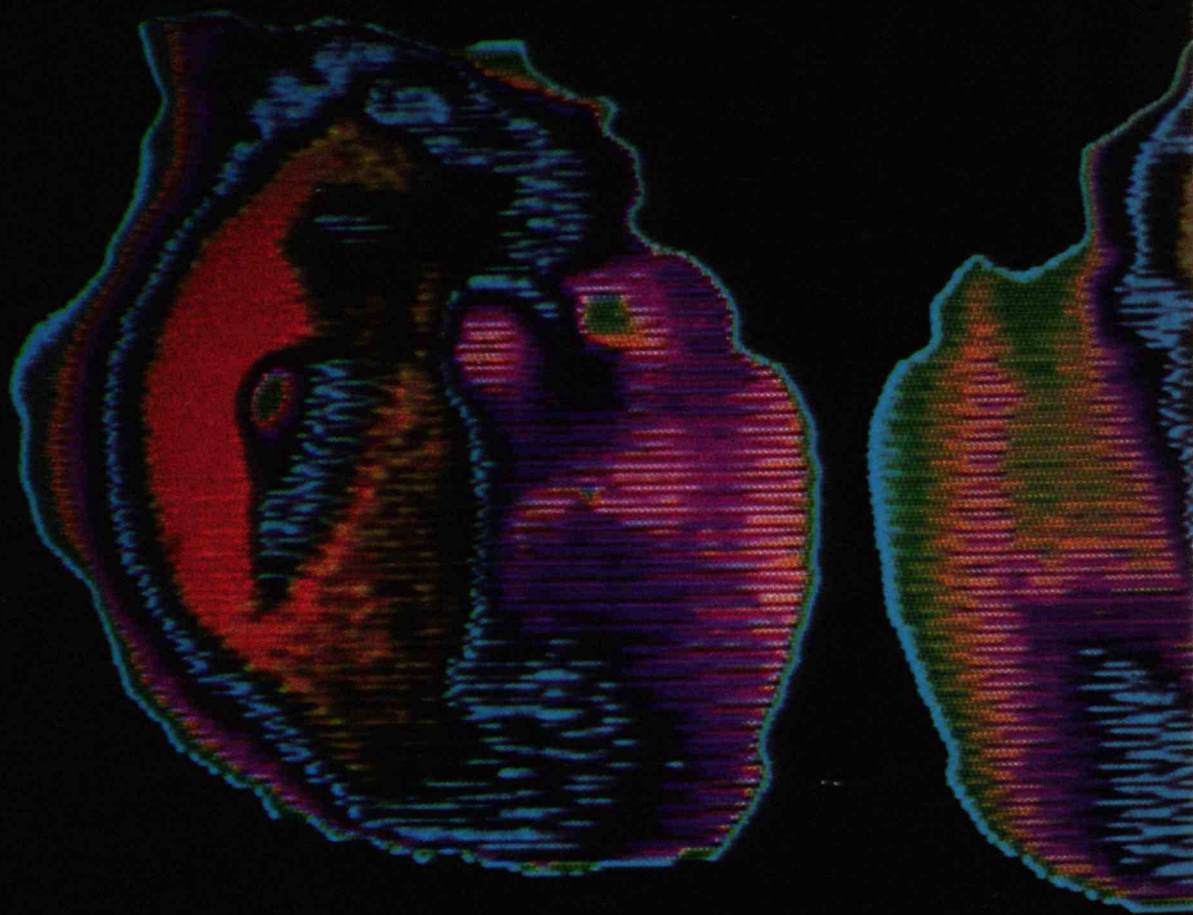
Other global bodies have made laudable attempts to control industry's behavior. The OECD Guidelines for Multinational Enterprises, the U.N. Code of Conduct on Transnational Corporations, and the ILO Tripartite Declaration of Principles Concerning Multinational Enterprises and Social Policy attempt to provide a framework of ethical behavior. The ILO declaration

of principles, for example, recommends that multinationals inform worker representatives about hazards and protective measures. But stronger medicine is needed.

When industry migrates to developing countries, governments and international lending institutions could require environmental impact assessments. The World Bank, along with other international lenders, now offers to produce such assessments when the host country can't. The bank has also taken steps toward requiring poor countries to put occupational and environmental protections in place as a condition for receiving development capital. Similarly, industrialized countries must insist that companies apply the same safety and environmental regulations to their manufacturing operations abroad as they do at home.

As part of this effort, countries need to cooperate to set global standards for occupational and environmental exposures to dangerous substances. Some newly industrialized countries have formulated lists of chemicals and metals that should receive priority regulation and enforcement. Yet these lists often contain laboratory reagents, rarely used chemicals, and other materials not likely to pose occupational and environmental problems, while omitting many highly toxic substances that see broad use. Industrialized countries therefore need to adopt one set of standards with which all companies manufacturing in poorer countries must comply.

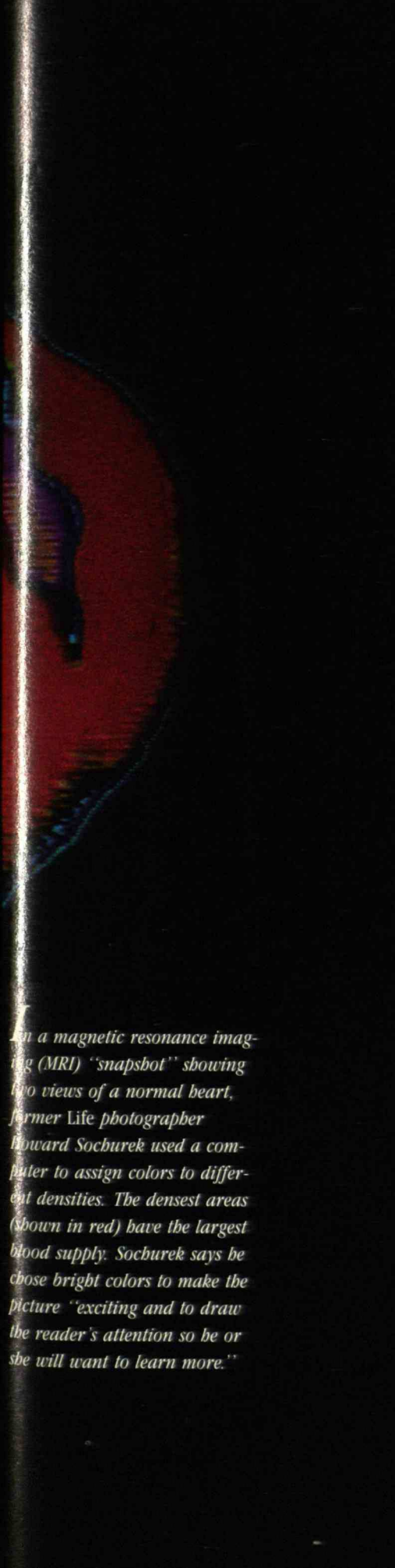
So far, both rich and poor nations see the short-term advantages in the export of hazardous industries but turn a blind eye to long-term harm. In the Third World and the First World alike, the risk of future accidents like Bhopal, the cost of environmental cleanup, and pollution's toll on public health are seldom discussed with candor. But as the developed countries have found, the longer environmental damage and hazardous working conditions continue, the greater the cost of remedying these problems once regulations and enforcement are in place. By disregarding such concerns, First World industries are shifting substantial burdens to those least able to bear them. ■



A PHOTO ESSAY

# Coloring the Invisible World

BY JOELLE BENTLEY



SCIENCE is coaxing the invisible world out of hiding and revealing it in vibrant colors. In fields from medicine to astronomy, technicians are using filters and computers to make vast realms of the electromagnetic spectrum vivid to the eye.

Colorization serves an informative function, speeding recognition of physical attributes. For instance, Billy W. Day, a post-doctoral toxicology fellow at MIT, uses a computer to colorize data yielded by x-ray crystallography to make the chemical bonding of atoms immediately apparent. His use of color adheres to the conventional palette of chemists—blue for nitrogen, green for carbon, and red for oxygen.

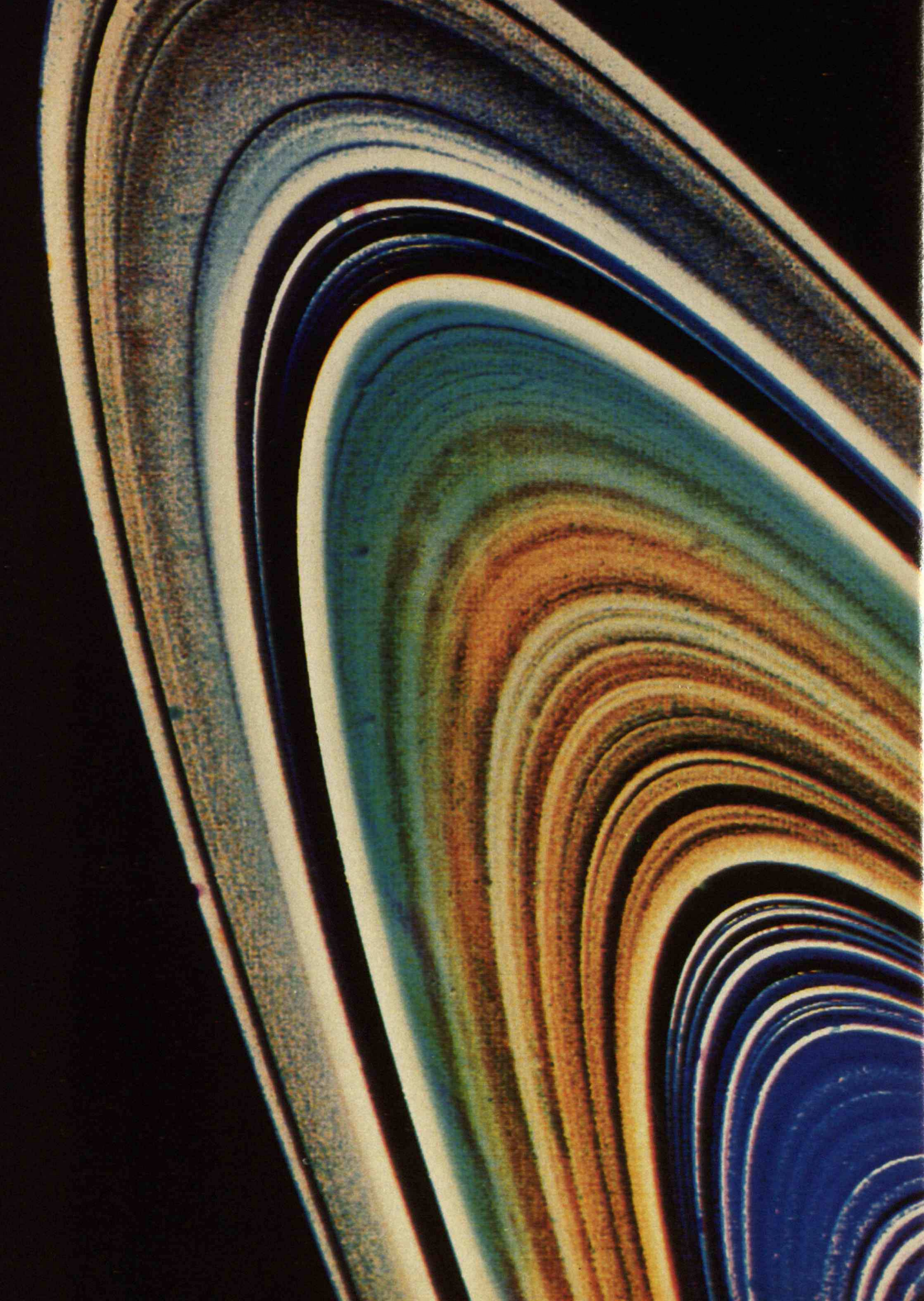
The color used to enhance many scientific images also has a powerful emotional component. In fact, some technicians and journalists purposely dramatize scientific images with color. Typically photojournalist Howard Sochurek colorizes magnetic resonance imaging (MRI) film not to aid doctors but to make pictures of medical case histories engaging to the public.

What role should color-filled images play in popular presentations of science and technology? Rudolph Schild of the Harvard-Smithsonian Center for Astrophysics worries about overuse of the “technicolor” pictures common to modern astronomy, which television producers and magazine editors are quick to snatch up. These “false-color” images have undisputed scientific value—they highlight everything from atmospheric composition to chemical differences in stars and planets. But he thinks they can misrepresent reality to the public. Because the pictures exaggerate nature, nonscientists who go on to glimpse real images through telescopes are often disappointed.

In the past century, some branches of science have shifted from hands-on experimentation toward numerical abstraction. But colorful imagery reintroduces a sensory component that delights scientists and public alike. Clearly the draw is powerful—the color of many of these images heightens our sense of awe for the worlds they reveal. ■

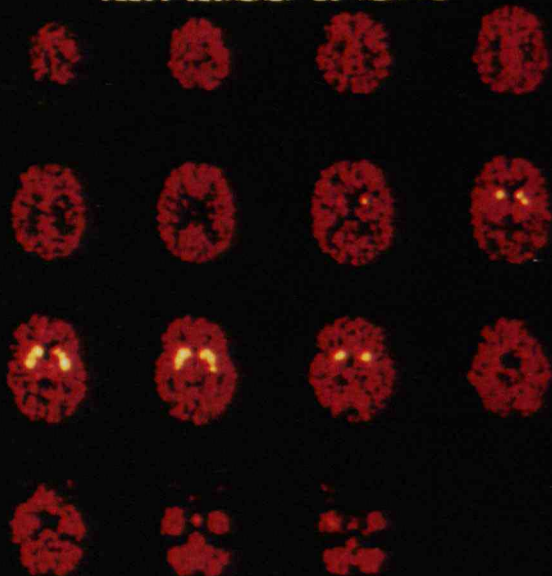
JOELLE BENTLEY writes on the relationship between science and the visual arts. She is director of Caduceus Fine Art, New York, a gallery specializing in medical art.

In a magnetic resonance imaging (MRI) “snapshot” showing two views of a normal heart, former Life photographer Howard Sochurek used a computer to assign colors to different densities. The densest areas (shown in red) have the largest blood supply. Sochurek says he chose bright colors to make the picture “exciting and to draw the reader’s attention so he or she will want to learn more.”



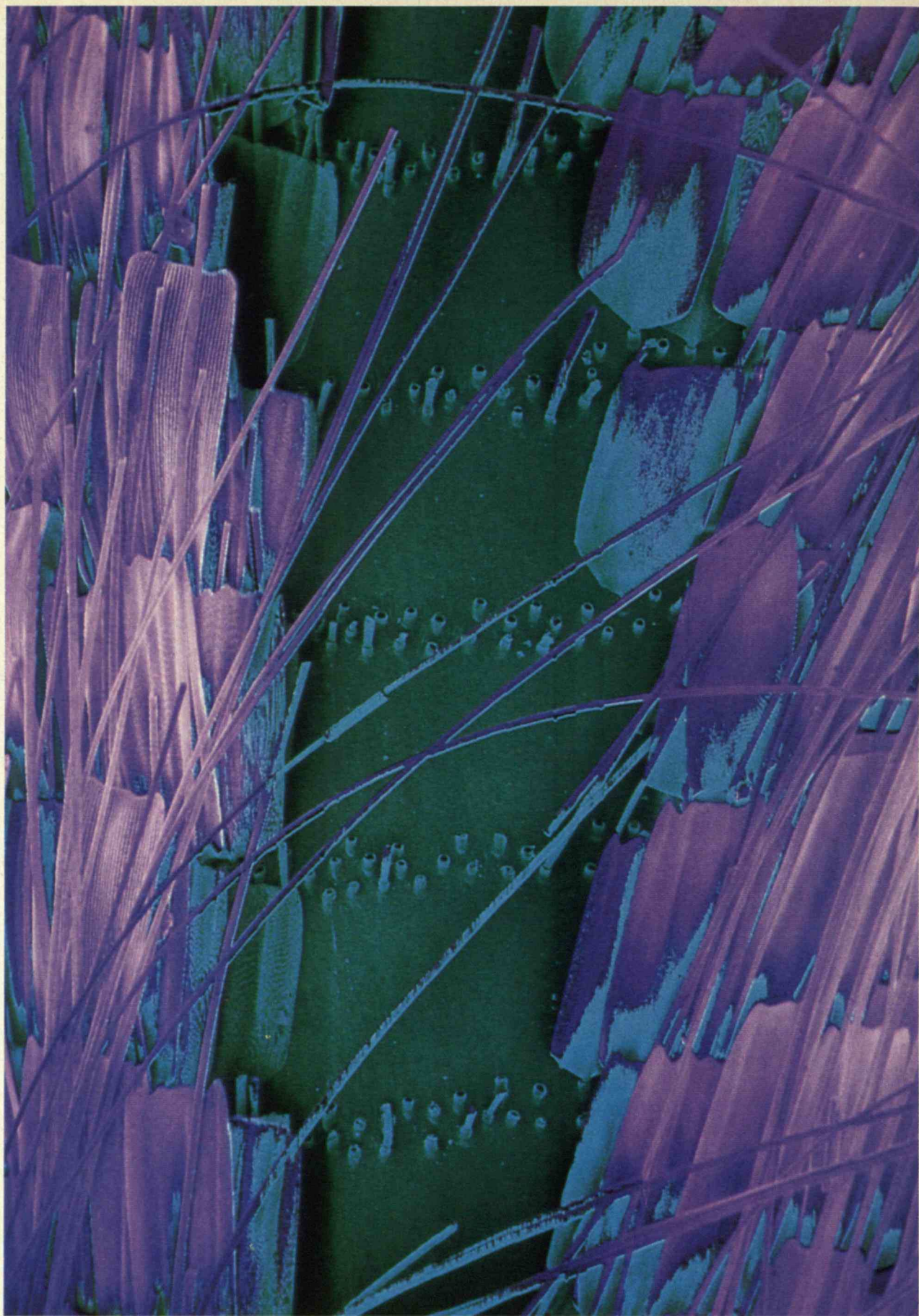


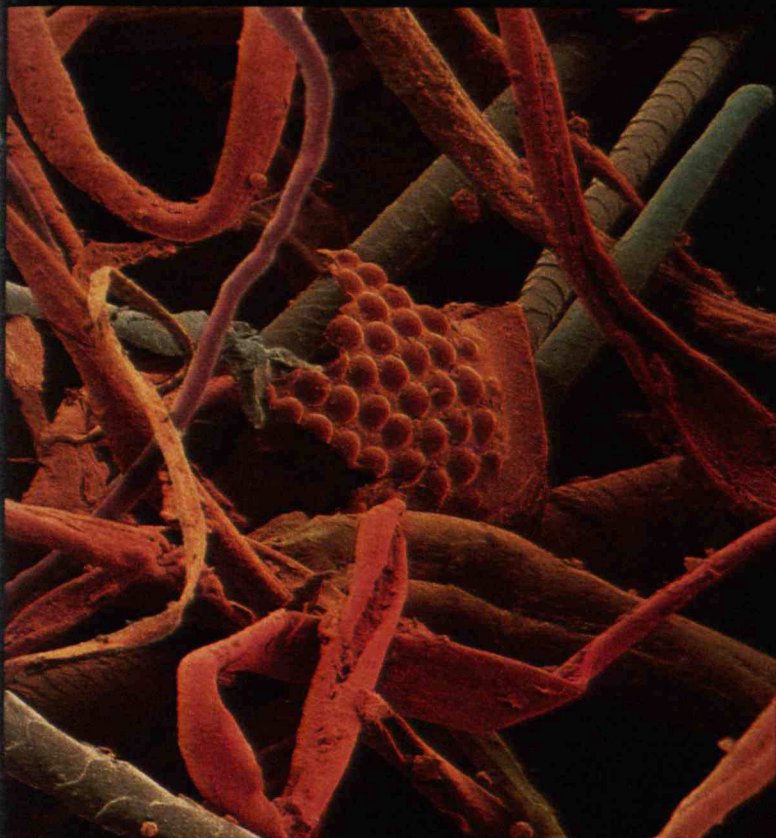
[11C]-COCAINE, 15 MIN PI



CTI-931 BNL PET PROJECT

Color gives immediate access to huge amounts of complex data that otherwise fill reams of paper with numbers. (1) In the course of their travels, the Voyager space probes used a series of filters on video cameras to generate false-color images of Saturn. Variations in the wavelengths of reflected light delineate different kinds of atmospheric activity. (2) Other filters show various materials that compose the planet's complex ring system. (3) Color correlates with biochemical function in these cross-sectional views of the human brain showing sites where cocaine has bound (yellow). Brookhaven National Laboratory scientists created the image using positron emission tomography, in which a computer constructs an image based on gamma rays coming from radioactive isotopes injected into the body. The computer enhances digital information with color as a visual aid.





As they colorize images, technicians sometimes step from the analytical to the aesthetic world. (4) Manfred Kage of the Institute for Scientific Photography and Cinematography in Germany used a scanning electron microscope to view a fragment of a *Urania* moth's wing. He then enhanced the monochromatic image by computer to vividly recreate the colors of nature. (5) Also using an electron microscope, David Scharf, a photographer trained in physics, captured the flotsam and jetsam of household dust: a piece of an insect's eye, human and cat hair, and cotton and synthetic fibers. As if to rival the still lifes of seventeenth-century Dutch realism, he then hand-colored the components of the scene using photographic toners. (6) To produce a picture solely for aesthetic reasons, geneticists and microscopists at the University of Rochester School of Medicine programmed a computer to randomly introduce colors in a purified sample of human DNA. Thomas Broker, who helped make the image, says: "In idle moments, it's enjoyable to look at the beautiful side of your work, to turn it into something gorgeous."

**A**strophysicist Rudolph Schild develops images of the "true" colors of stars and galaxies with charge-coupled device (CCD) technology, which allows for accurate light readings over long distances. In this Schild image (7), most galaxies—which look like stars here—appear white. That's because most stars burn in the range of 9,000 degrees Fahrenheit, where wavelengths are emitted in equal parts of red, green, and blue—a mixture the eye detects as white. The blue galaxies are hot and young, the red ones cool and old. To heighten the differences, Schild saturates the galaxies' hues.

But Schild is also drawn to applying false color at times. (8) This picture, which he made with the help of a filter, shows infrared radiation emitted by a nebula (a cloud of interstellar debris) in greenish blue. Schild did not create the image so much to confirm the amount of infrared as to savor its beauty. "This image," he says, "was done for visual pleasure."



## PHOTOS

PAGE 54: HOWARD SOCHUREK

PAGES 56-57: NASA/JET PROPULSION  
LABORATORY; BROOKHAVEN  
NATIONAL LABORATORY/SUNY STONY  
BROOK

PAGES 58-59: MANFRED KAGE/PETER  
ARNOLD INC.; DAVID SCHARF/PETER  
ARNOLD INC.; CHOW, INSEL, BROKER,  
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PAGE 60: RUDOLF E. SCHILD/HARVARD-  
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# Engineers and the Nintendo War

**W**HILE briefing the press during the final hours of the war against Iraq, General Norman Schwarzkopf told reporters not to forget that human lives were at stake. "This is not a Nintendo war," he said sternly.

I thought the point well taken. Yet, as Desert Storm moved to its swift and stunning conclusion, I found myself slipping into a Nintendo frame of mind. I could not help but be dazzled by what *Newsweek* called "the boy-toy glow surrounding high-tech weapons." The war had seemed a grand display of technical ingenuity—a triumph for the nation's technologists as well as its fighting forces. The ingenious contraptions worked, and the engineer in me responded with an affirmative "Wow!"

Of course, one didn't have to be an engineer to marvel at TV pictures of laser-guided bombs flying into air vents, or to be awed by tales of cruise missiles following computerized maps to distant targets. There is a primal "Eureka!" that lurks deep within the human psyche. There is also a fierce and wary barbarian who wants to see the target hit.

Yet, after the frenzy of battle had passed, I found myself troubled by second thoughts. How can engineers take satisfaction in the remarkable victory without also feeling acute discomfort? For a profession whose self-definitions and codes of ethics have always stressed the welfare of humankind, a ballistic missile, no matter how "smart," cannot serve as a badge of honor.

It helps somewhat to recognize that most engineers are engaged, not in weaponry, but in life-enhancing work. But the stark fact is that 20 percent of American engineers are directly engaged in military projects, and many others are tangentially involved through their work in electronics, computers, and other specialties. Even the profession's historic roots are intertwined with military enterprise. The very word "engineer" was first used to describe the designers of "ingenious devices," particularly catapults used by Roman armies. There is some comfort, but not much, in observing

that advances in weaponry have made it possible to reduce mass destruction by more accurately attacking military targets. As *Science* magazine editor Daniel Koshland wrote, the concept of "humanizing war" is the ultimate oxymoron. I've heard it said that technology, through the medium of television, has served to turn Americans away from war by bringing battle scenes into our living rooms, but I'm not at all convinced that this is so.

There is, however, a way in which engineers can find satisfaction in the recent conflict other than the obvious, but uncomfortably ambiguous, pride in technical skill.

Operation Desert Storm differed from previous wars by revealing in our society a heightened concern for individual human lives. How striking it was that President Bush, General Schwarzkopf, and other political and military leaders

save people from untimely death, lives seem more precious than they did during the wars of generations past. In retrospect, World War I's trench warfare and World War II's carpet bombing of cities seem unspeakably barbaric. Our leaders carefully crafted their Desert Storm pronouncements to reflect the evolving concerns of a citizenry that wanted war but not bloodshed.

Beyond their development of life-saving technologies, engineers have also furthered this aversion to mass slaughter by creating a worldwide communications structure that is beginning to link humankind in a network of empathy. During England's fifteenth-century War of the Roses, the marauding armies, for all their ferocity, did not engage in the civilian massacres typical of the age. One explanation for this restraint was that the war took place on the relatively small island of Britain, where people, over



shied away from talk of killing. There was not only an unprecedented effort to minimize casualties—at least among the allies—but also a studied determination to avoid discussing them. There was death and suffering aplenty, but, perhaps for the first time in the history of war, nobody wanted to talk about body counts.

This reluctance to boast of killing the enemy represents an amazing step forward on the road to civilization. Engineers can take a share of the credit, for two reasons.

First, in a world where we have learned to grow food for multitudes, combat deadly diseases, and otherwise

time, would have to live with each other. As technological advances make our world "smaller," a similar feeling of mutual dependence may be evolving on a global scale.

This greater sense of planetary community might move us to devote our lasers, computers, and satellites to disarmament and monitoring in the cause of peace. Perhaps the term "Nintendo war" reveals not only our failings but also our hopes. ■

*SAMUEL C. FLORMAN, a civil engineer, is the author of Engineering and the Liberal Arts, The Existential Pleasures of Engineering, and The Civilized Engineer.*



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# When Will the Recession End? Who Cares?

**B**Y the time you read this, the recession of 1990–91, officially declared last December in Washington during the annual convention of economists, may be just about over. Or maybe it won't. Then again, for some purposes the precise duration of the recession is not terribly important—the country's economic outlook will still be pretty dismal.

The United States faces a distressingly long list of economic troubles. These problems were with us long before the "short" cyclical downturn that began in the fourth quarter of last year, and will be around long after a recovery is declared by the gurus of the National Bureau of Economic Research (the official guardians of the privilege to call a downturn a "recession").

One important symptom of the economy's weakness is the slow rate at which industrial productivity has been growing. During the recent cycle from 1979 to 1988, annual productivity growth across all U.S. industries lagged behind that of not only Japan but also Canada, France, the former West Germany, Sweden, and Italy. Even Britain managed to outperform us. (I draw these and other statistics from *The State of Working America: 1990–91*, a remarkably useful compilation produced by Larry Mishel and David Frankel at the Economic Policy Institute in Washington.)

During the past few years, manufacturing productivity seemed to rebound. But the latest evidence confirms that the good news was confined mainly to computer makers. Other sectors continued to limp along. Where there were gains, the productivity improvements came largely from the "rationalization of older capacity"—that's economist talk for layoffs and plant shutdowns. And over the past six months or so, even the computer industry has begun experiencing some distress.

Unfortunately, we cannot look to technology as the white knight that will return our industrial vigor. The anemic gains in U.S. productivity coincided with the introduction of large amounts of workplace automation—from car-

painting robots to word-processing computers.

The underlying causes of this economic malaise are still only partly understood. But no expert imagines that recovery from the current recession will, by itself, lift us above the dismal 1.09 percent average annual rate of productivity growth of the last 10 years.

When the recession of 1990–91 was but a gleam in the eye of the forecasters, it was already well known that Americans were working more hours for fewer real dollars in the late 1980s than they had in 1979, or even as far back as 1973. On the eve of this recession, the average U.S. worker earned less—both before and after taxes—than in 1980. The proportion of our citizenry in poverty was higher in 1989 than at any time since 1967. And the last time it was possible to make systematic comparisons, the United States had more income

than we do on this score, but the consequences are less severe because of the substantial training efforts of the country's large private companies.

We should therefore not imagine that when victory is officially declared over this recession, the roads will be in better shape, the bridges repaired, our almost nonexistent rail transport system reinstated to its former glory, homelessness on the wane, infant mortality reduced, or the viability and credibility of our banking system restored. About all we can say with any certainty is that officially measured unemployment will be lower than it is today.

But declining unemployment is not by itself a reliable indicator of economic health. In 1989, for every 100 persons officially unemployed, 85 others were either involuntarily working only part time or had dropped out of the active labor force altogether because they



inequality than any of our major trading partners (and even some of our minor ones).

Government inaction is partly to blame for our economic weakness. In 1988—again, before the current recession began—all levels of government in the United States were spending one-quarter of one percent of the gross domestic product to create jobs and to train and place workers. The Canadians spend twice that proportion, the Germans four times as much. The Swedes are the world champs, spending fully 1.8 percent of their GDP helping people get ready for or go back to work. The Japanese government does a little worse

couldn't find a decent job.

The media have fixated narrowly on the current recession, inviting pundits to deliver long-winded speculation on its causes (the Gulf War? continuing high real interest rates? loss of consumer confidence?) and on when we will come out of it. If only half of this energy had gone toward thinking in public about the country's underlying long-term economic problems, we would all be better off. ■

*BENNETT HARRISON is professor of political economy in the School of Urban and Public Affairs at Carnegie Mellon University. His most recent book, coauthored with Barry Bluestone, is The Great U-Turn (Basic Books, 1988).*

# Reviews

## BOOKS

### ENGINEERING WITH A HUMAN FACE

*What Engineers Know and How They Know It:  
Analytical Studies from Aeronautical History*

by Walter G. Vincenti

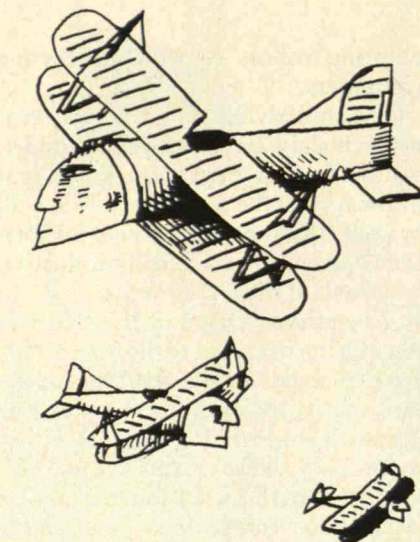
Johns Hopkins University Press, \$45

BY JOHN STAUDENMAIER

THE products of engineering—aircraft, telecommunications systems, computers, manufacturing processes—dramatically influence our lives and shape the social order. Yet popular books about “what technology is doing to us” (Alvin Toffler’s *Third Wave* and John Naisbitt’s *Megatrends* spring to mind) tend to treat technologies with simplistic awe, as if they had descended, fully designed and ready to operate, from some modernistic heaven. Often lacking in such accounts is careful attention to the people who design and maintain the technologies.

Large-scale technologies such as the interstate highway system and satellite communications represent human beings who debated some set of options and then decided to do things a certain way—serious money for highways instead of railways, for example. But when such technologies are talked about apart from the processes that bring them into being, they appear inevitable, like the weather. People often relate to technology with the passivity of infants rather than the questioning stance of adult citizens.

Walter Vincenti, a long-time scholar and practitioner of aeronautical engineering at Stanford University, seeks to remind us that every technology is a completely human construct. Embedded in its design are the values and limitations of specific engineers and planners. Most recent sophisticated



studies of technological practice examine the political struggles that take place at the high end of the design hierarchy. *What Engineers Know and How They Know It* focuses instead on the day-to-day work of engineers. Through case studies from the first half-century of aeronautical engineering, Vincenti asks: How do engineers think? How do they interact with one another? What kinds of funding and time constraints impinge on their work? What motivates them? By paying attention to the human side of engineering, Vincenti helps render large-scale technologies less mythic and more accessible to debate and criticism.

Vincenti’s examples show the daily thinking of working engineers to be an untidy business. “As any engineer knows, the technological learning process always requires more effort in fact than appears necessary in hindsight. . . . The learning, in short, while it is going on is messy, repetitious, and uneconomical.”

To a large extent, Vincenti sees the engineering process as a battle against uncertainty. Over time, he argues, the engineering of any technology (including aircraft) tends to reduce the level of uncertain or loosely defined thinking in favor of precise theory and predictability. Engineers see uncertainty—the spontaneous, the surprising, the subjectively debatable—as an expected but

uncomfortable condition. It is a challenge to their expertise that demands painstaking testing and data gathering before it can be rationalized into helpful theories that will guide subsequent practice. But as Vincenti points out, uncertainty is also central to engineers’ creativity. It is the force that drives the profession to reach beyond design orthodoxies.

As an example, Vincenti traces the 25-year period (1918–43) when aeronautical engineers worked with test pilots to establish a formal theory of “flying quality.” The problem interests Vincenti because “the learning process . . . provides an example of how an engineering community translates an ill-defined problem, containing in this case a large subjective human element, into an objective, well-defined problem for the designer.”

Early on, pilots tended to talk about an airplane’s flying quality in language that was too vague to help aircraft designers. A 1918 test flight report, for example, stated: “The longitudinal, lateral, and directional stability of this machine is good.” Gradually, design engineers and test pilots learned to communicate across the divide that separates the subjective experience of the pilot’s feel for the way the plane handled from the designers’ need to codify specifications in precise terms. One way they did this was by testing the machines together. Engineers in the 1930s would routinely go on test flights with pilots, who would point out desirable or undesirable flying characteristics.

Through a mix of discoveries and decisions over the years, engineers and pilots concluded that stability in flight was more important than a high degree of responsiveness to pilot control. This judgment, writes Vincenti, was “rendered, not from careful deliberation by an individual or individuals, but more or less instinctively by the flying-quality community as a whole.” The same loose, communal decision making also shaped the development of rivets that ride flush with an airplane’s skin. Helped by close contact with skilled

## BOOKS

## POETRY AND CHEMISTRY

*Gaps and Verges*

by Roald Hoffmann

University of Central Florida Press, \$14.95

BY DEREK A. DAVENPORT

**I**N his advertisement to the 1798 edition of *Lyrical Ballads*, William Wordsworth wrote:

*It is the honorable characteristic of Poetry that its materials are to be found in every subject which can interest the human mind. The evidence of this fact is to be sought, not in the writings of Critics, but in those of Poets themselves. The majority of the following poems are to be considered as experiments. . . .*

For a chemist the word "experiments" leaps from the page, and it is worth remembering that Wordsworth and Coleridge entrusted to the chemist Humphry Davy the task of proofreading their book. Later Coleridge was to admit that he went to Davy's popular lectures at the Royal Institution in London "to replenish his stock of metaphors."

Davy was by no means the first chemist to aspire to poetry, nor, as we shall see, was he the last. In truth, he was not a good poet (he was a far better salmon fisherman), but at least no one thought it odd that he should try his hand. The growing professionalism of the sciences had not yet led to their being excommunicated by the humanistic priesthood.

By contrast, the thought of a contemporary chemist writing poetry brings to mind Dr. Johnson's opinion of women preachers and dogs walking on their hind legs: it's not that they do it well but rather that they do it at all. Nobel laureate Roald Hoffmann's second book of poetry, *Gaps and Verges*, provides an interesting test case for this uncharitable generalization.

As is hardly surprising, Hoffman's poems—including many of those in his latest volume—often reflect his chemical training. (Although the Law of Microscopic Reversibility requires that his poetry should also have an effect on his chemistry, I'll not pursue that antic thought.) But is Hoffmann a poet who happens to be a chemist or a chemist who happens to write poetry? In the course of one or more revolving moons he is, I believe, both. Consider:

## TERRORISTS

*In the dark that is the bed,  
in the dark, that is the sole  
room in this life, we seem*

*to be taming a cat. The woman  
with me is wife, or mother,  
or both, and we are intent*

*on this impossible task of  
training an animal we can't  
see. We do hear it, its pacing,*

*always out of reach, and when  
it jumps (this we have learned  
to fear most, the silent space*

*of its jump) it lands claws out,  
with the smooth unthinking cat  
cut of claw into skin and flesh.*

*The sheets are twisted, they will  
be bloody in the morning. Lately  
it seems to be timing its jumps.*

*The woman and I are not sure  
who in this night of training,  
will be taught to kill whom.*

Whatever dark night of the soul prompted these lines, there is no question of their poetic power. And nary a chemical metaphor in sight.

In sharp contrast is a poem, not included in the present volume, on political terrorism. *Giving In*, paired with a collage by artist Vivian Torrence, is part of Hoffmann's and Torrence's exhibit *Chemistry Imagined*, which opened its national tour at Purdue University last fall.

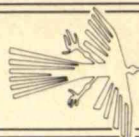
workers, an informal network of engineers at different companies learned how to make rivets flush (to eliminate drag) without weakening the supporting metal. So when Vincenti talks about engineering knowledge being a messy business, he is referring not only to the uncertain movement from subjective experience to precise theory but also to the informal, collective way in which design decisions often arise.

The untidy cognitive processes that Vincenti reveals belie the twentieth-century myth of precision in technology. Our media environment—not only advertising but also newscasts and theme parks such as Disney's EPCOT Center—is awash with sanitized images of precise technologies: of smart bombs that always hit their targets, of computers that never make mistakes, of cars that always work. Despite unavoidable exceptions such as coverage of the Challenger disaster, the "default mode" for technological imagery in our society is the exact and efficient.

The engineers who preside over these mythic technologies, such as the typical "expert" featured in 40 years of pro-nuclear advertising, are portrayed as surefooted and error-free oracles. Their claim to our allegiance rests not on integrity, courage, and humor (qualities displayed by the engineers in Vincenti's book), but on a godlike certitude. Disneyesque advertisements treat human ambiguity and uncertainty with contempt. And they try to intimidate anyone who would debate the tradeoffs inherent in every technological design.

The biggest contribution of Vincenti's splendidly crafted book may well be that it offers us a believably human image of the engineer. If the experts turn out to be ordinary human beings, subject to the same play of uncertainty, surprise, achievement, and failure as the rest of us, then they suddenly become answerable to the citizenry for how they allocate the resources of the body politic. ■

JOHN STAUDENMAIER, S.J., is a professor of the history of technology at the University of Detroit Mercy.

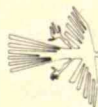


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## REVIEWS

### GIVING IN

*At 1.4 million atmospheres xenon, a gas, goes metallic. Between squeezed single-bevel diamond anvils jagged bits of graphite shot with a YAG laser form spherules. No one has seen liquid carbon. Try to imagine that dense world between ungiuing diamonds as the pressure mounts, and the latticework of a salt gives, nucleating at defects a shift to a tighter order. Try to see graphite boil. Try to imagine a hand, in a press, in a cellar in Buenos Aires, a low-tech press, easily turned with one hand, easily cracking a finger in another man's hand, the jagged bone coming through, to be crushed again. No. Go back, up, up like the deep diver with a severed line, up, quickly, to the orderly world of ruby and hydrogen coloring near metallization, but you hear the scream in the cellar, don't you, and diver rises too fast.*

Here the terror is equally vivid, though less personal—it is a terror to be shared. The technical details are more an incantation than an attempt to inform, though much will be lost if the reader does not realize that 1.4 million atmospheres is a hellishly high pressure. Hoffmann modulates from fact to fancy to the almost physical reality of subterranean pain—and the bend sinister in the last two lines precludes a too rapid rise to the sunny, unpressured surface.

Chemical imagery abounds in many of the poems in *Gaps and Verges* as well. Chemists are either blessed or cursed with a vocabulary of more than 10 million words, each one—like Hoffmann's "N-acetyl-5-methoxytryptamine, a mine of a name"—evoking macroscopic and microscopic worlds of their own. Is not a chemist as fit as William Blake (friend of Joseph Priestley) to see a

world in a grain of sand? Of course, but not necessarily the same world. Are not our beloved molecules, with their "sweet and airy chaos," themselves metaphors for this oh too stolid world? One poem, *Jerry-Built Forever*, is riddled with such molecular images. Indeed, it is so didactic that the interested reader is referred to the third edition of Lubert Stryer's *Biochemistry*.

### JERRY-BUILT FOREVER

*We think that all that matters  
can't be deep, but chunk-to-  
knowledge-chunk in subsurface  
veins, and we, mind-armed miners  
search/dance to lift earth cover,  
free the plan. . . .*

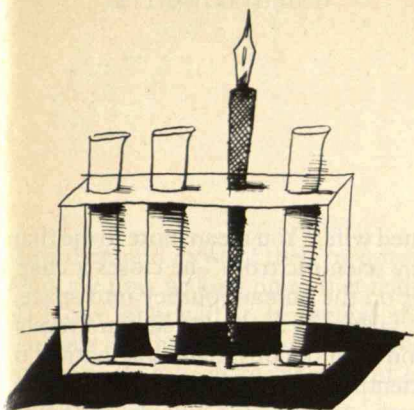
*If God's  
plan for all this function  
be heresy, at least let  
what came, chanced, to be*

*be best. Heme, myo- and hemo-  
globins, vertebrates' O<sub>2</sub>  
transport proteins, subunits'  
trim fit link—evolved.*

I don't know whether it is poetic good manners to end lines with hyphens, let alone subscripts, but I'm fairly sure that this attempt to infuse biochemistry with a muse of fire has largely failed. Not that I think such fusion impossible. If Kipling could write superb verse (if not quite Eliotian poetry) about the harnessed energy of steam engines:

*Lord, Thou hast made this world  
below the shadow of a dream.  
An', taught by time, I tak' it so—  
exceptin' always Steam.  
From coupler-flange to spindle-guide  
I see Thy Hand, O God—  
Predestination in the stride o' yon  
connectin'-rod.*

then some poet waiting to be born should be able to do the same for the body's molecular harnessing of ambient energy. Oh, for a second coming of Kipling—or better still, Blake:



*Energy is the only life, and is from  
the Body, and reason is the bound or  
outward circumference of Energy.  
Energy is Eternal Delight.*

In contrast to the tangled metaphors  
of *Jerry-Built Forever*, Hoffmann is else-  
where the soul of simplicity:

#### INTUITION

*The red-haired woman  
said glass  
is tense.  
She didn't know  
about disordered  
silica chains, rings  
and structural  
frustration.  
She just looked  
at its fractured  
green  
edge.*

Here the chemist-poet has been  
struck by a realization about scientific  
verities that must also have occurred to  
Blake, who implored: "God forbid that  
Truth should be confined to Mathematical  
Demonstration."

The poem also invokes a microscop-  
ic world inherent in a "grain of sand"  
that Blake could not possibly have  
known. The chemist's mind is essential-  
ly schizophrenic: a fine diamond is  
beautiful both in its dazzle and in its  
microscopic structure, with its inter-  
locking six-carbon-atom chairs rocking  
their way to infinity. Thus, not only is  
Blake's grain of sand a possible seed  
crystal for a pearl, it is also "disordered  
silica chains, rings and structural frus-  
tration." Chemists, of all hair shades or  
none, can treasure their view of the frac-  
tured glass in a poem from *The  
Metamict State*, Hoffmann's previous  
volume:

#### DECEPTIVELY LIKE A SOLID

*... chains, rings, of Si*

*alternating with oxygen  
each silicon tetrahedrally  
coordinated*

*by O's, each oxygen  
ion, so different from the  
life-giving, inflaming*

*diatomic gas, joining  
two silicons; on to rings  
in diamondoid*

*perfection in cristoballite;  
helical O-Si-O chains  
in quartz, handed in*

*coiling, mirror images  
of each other, hard, ionic  
SiO<sub>2</sub>*

Coleridge was surely right to go to Da-  
vy's lectures. The metaphorical pickings  
are rich beyond compare.

Hoffmann is particularly good, as be-  
fits the natural philosopher, at minute ob-  
servation. Water fascinates him, and  
poems such as *Intravenous*, *Hydropathic*,  
and *Denizen* are appropriately hydrofelic-  
itous. So too is his attempt "to imagine  
the sound of the pastors of Ireland pass-  
ing water" in *Eschatology*. The range of  
allusion and reference is extraordinary:  
from Gaudi to Grand Unification The-  
ory, from Klee to Kierkegaard, Brodsky  
to Larry Bird, Rostropovich to *Rhinecan-  
thus aculeatus*. The author modestly  
claims in *Somewhere* that "in me are hid-  
den constellations," and he shakes stars  
and aces from his asymmetric sleeves with  
dazzling aplomb.

If his constellation straddles two seem-  
ingly incompatible disciplines, perhaps it  
is because in Hoffmann they are one.  
Both his science and his poetry, he has  
written, "emerge from an attempt to un-  
derstand the universe around us, from my  
own personal affection for teaching what  
I've learned, and from an infatuation with  
language—the English language, other  
languages that geopolitical accidents have

thrust into my head."

Do our chemistry departments harbor  
other closet poets yearning to undertake  
Wordsworthian "experiments"? Precious  
few, I suspect. Looking at the eager and  
anxious faces of my younger colleagues,  
I rarely see evidence of the *poète  
manqué*. Unlike our famous advocate of  
the iso-lobal principle of molecular ar-  
chitecture, they seem content to operate  
with only one side of their brains. ■

DEREK A. DAVENPORT is a professor of chemis-  
try at Purdue University.

#### FILM

### FOUND IN SPACE

*Solaris* (1972)

Directed by Andrei Tarkovsky

BY GERALD PEARY

**A**LTHOUGH he made only seven  
features in 25 years, from  
*Ivan's Childhood* (1961)  
through *The Sacrifice* (1986),  
Andrei Tarkovsky was celebrated  
around the world as the greatest Rus-  
sian filmmaker since World War II. But  
dying of cancer in 1986, he chose to end  
his days in France, in self-exile from the  
Soviet Union. As Tarkovsky showed in  
the 1972 science-fiction film *Solaris*,  
playing in the United States for the first  
time in its full 2-hour-and-45-minute  
version, he was estranged from a soci-  
ety that esteemed scientific knowledge  
and technological advancement above  
the philosophical and aesthetic truths of  
artists, including filmmakers. Produced  
at a time when the Soviets were pour-  
ing billions of rubles into their first  
space station and lofting ever greater  
numbers of cosmonauts on simultane-  
ous missions, *Solaris* argues that the  
tools of science are inadequate for un-  
derstanding the cosmos.

Tarkovsky's movie, freely adapted

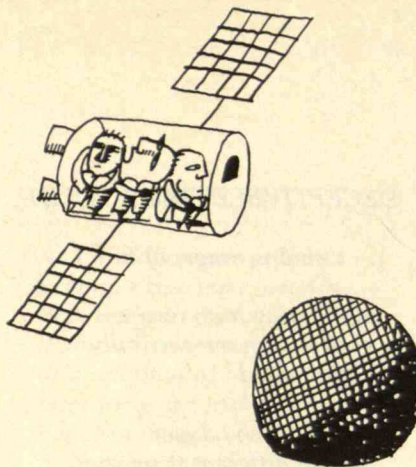
from the 1961 novel by Poland's Stanislaw Lem, tells of an oceanic planet, Solaris, that appears to be living and sentient. Excited scientists from earth, including psychologists, physicists, and cyberneticists, rush in, determined to make contact. Unfortunately, the planet refuses to cooperate, foiling every attempt at communication. Finally, all that remains of earth's many quests is a dysfunctional space station floating above Solaris's bubbling waters.

The film's protagonist, Kelvin, arrives from earth to investigate. He discovers that the three scientists in the space station have irradiated the planet's surface in an experiment at communication. Solaris has responded obliquely, turning the tables: the scientists become frazzled rats in a maze. Each is plagued by an apparition from his guilty past, which follows him slavishly about the space station. Conscience-stricken, two of the scientists have nervous breakdowns, and the third kills himself.

Kelvin, too, is pursued—by the hologram-like figure of his ex-wife, who committed suicide when he abandoned her. He tries to get rid of her anew, even by blasting her off into space. But she keeps reappearing. Kelvin finally stops trying to annihilate her, resolving instead to love, honor, and obey his simulacrum spouse.

The film places Kelvin's personal fulfillment in sharp relief with the course of the scientific mission to divine the nature of Solaris. It's not only radiation that has failed. *Solaris* is filled with scenes in which characters watch video screens in futile attempts to learn "facts." Technology proves inadequate, the "reality" too elusive for human understanding. The most telling sequence involves characters watching a video documentary of a scientific meeting where the scientists and gathered military also watch documentary footage taken of Solaris. This video-within-a-video-within-a-movie is supposed to reveal what really happens on the surface of the cryptic planet.

*Solaris's* great epiphany? Tarkovsky frustrates everybody—including the



film's audience—who counts on technology to reveal the "truth." What shows up on the video-within-a-video-within-a-movie is sudsy and foggy, visually unreadable. So much for "knowing" Solaris. The planet is so alien that scientific instruments, unavoidably anthropomorphic, are useless.

In fact, Tarkovsky, the supposedly omniscient filmmaker, is also limited in his cognition of Solaris because of his dependence on the motion picture apparatus. Like the microscope and the telescope, the movie camera can capture only certain kinds of "realities." As Tarkovsky explains in his posthumous volume of essays, *Sculpting in Time* (1986): "One of the most important limitations of the cinema, if you like, is the fact that the image can only be realized in factually natural forms of visible and audible life." Scientists, technologists, filmmakers can "see" and "know" only what is already somehow familiar to the eye and brain. But Solaris is outside their conceptual framework.

For Tarkovsky, both the derailing of the Solaris project and his own inability to capture the ineffable on film are anything but tragic. The consolation is a far more important journey of discovery: Kelvin, the tunnel-visioned scientist, has begun to operate like an artist, seeing his encounter with the inscrutable planet as a path into his own unconscious and pledging himself to the recuperation of the human heart. As Tarkovsky argued in *Sculpting in Time*, "Works of art, unlike those of science, have no practical goal in any material sense . . . [except] realizing the idea of love, . . . the very antithesis of pragmatism." When Kelvin tells his resusci-

tated wife, "You mean more to me than any scientific truth," he closes a chapter on the human journey into space.

Tarkovsky contrasts Kelvin's revelation with the obstinate pragmatism of scientific and military leaders back on earth. Surrounded, in classic Soviet fashion, with elephantine blowups of Big Brotherly politicians, they view the cryptic footage of the ocean planet. Even with strong evidence that Solaris is impenetrable—its mysteries beyond human grasp—they decide to plunge on. "We have no moral right to discontinue the investigation," they argue. Here is Tarkovsky's pre-glasnost, "space race-at-any-cost" Soviet Union.

Not surprisingly, the Soviet government raised official political questions about many of Tarkovsky's films, branding them elitist—inaccessible to the average citizen—and non-Marxist. In this case, their concern was perhaps not without foundation, since *Solaris* is hardly a propaganda vehicle for state-directed research. It is, if anything, an anti-space exploration sci-fi movie.

It's not that Tarkovsky was against science. In fact, he was careful to posit several ways in which the scientific quest and the aim of cinema (and art in general) converge. Both exist "to explain to people the reason for their appearance on this planet" and both have as "a general aim" a "mastery of the world." In *Sculpting in Time*, Tarkovsky also draws a parallel—perhaps a slightly strained one—between the engineer, who "invents machines, guided by people's daily need," and the film artist, who strives toward "making life better, more perfect, . . . easier for people."

Still, given a choice between the emotional probings of the artist or what he calls the "cold, positivistic, scientific cognition of the world," Tarkovsky does not conceal which brand of truth he prefers. Make love, not Sputniks, *Solaris* says. ■

GERALD PEARY is an associate professor of communications and journalism at Boston's Suffolk University and a contributing editor for American Film.

Me either, and most of their own residents are now waking up to that reality. How long will it be before the denizens of American universities and international bureaucracies wake up to it themselves?

LEW FLAGG  
Milford, Mass.

### The author responds:

In his rush to trivialize the problem of rapid population growth, Mr. Flagg has failed to read my article. I did not call for more abortions. Nor did I make a "gratuitous reference"—or, for that matter, any reference—to the defense budget.

I suppose that all the people in the world might theoretically fit into Texas or Australia, but you certainly could not feed, educate, or employ them. Although density can be a manifestation of overpopulation, it hardly tells the entire story. Overpopulation exists when a country's population overwhelms its resources, and this is not always reflected in visible overcrowding.

Moreover, diminishing food supplies can be expected in the not-too-distant future. And even if everyone in the world could eat better than the average American for what we pay U.S. farmers not to farm, as Mr. Flagg contends, people are still going to have to be paid for growing, transporting, and distributing the food.

Mr. Flagg's call for more social freedom sounds suspiciously like the Reagan-Bush thesis that capitalism is the best contraceptive. Unfortunately, there's little evidence to support this notion. Both India, whose population grew by 161 million over the last decade, and Kenya, which has one of the highest fertility rates in the world, have long histories as free-market economies.

Countries with more stable economies do tend to have lower fertility rates. But the fact remains that high fertility in many developing countries has increased population greatly. There is little hope for improved development in these nations until the numbers are voluntarily stabilized.

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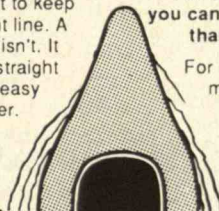
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# Notes



## Better Bats

Fifteen years after the first aluminum baseball bats, three of four bats sold are made of the metal. But aficionados miss the sharp crack of hardwood and shudder at aluminum's high-pitched ringing.

Now the Tufts University baseball team is helping to try out wood-composite bats for Michigan inventor Steve Baum. The composite measures up in early tests, yielding more hits and longer distances. Says the coach, the ball explodes off the bat. As for aesthetics, the composite produces hardwood's "signature" crack in a frequency analysis.

## Pollution Profits

Maine's Passamaquoddy Indian tribe is conducting commercial tests of an innovation that could make pollution control yield profits for hundreds of cement kilns. Rather than relying on expensive chemicals to absorb pollutants from the kilns' dirty exhaust gases, the technique uses discarded dust to "scrub" emissions clean.

While seeking to dispose of solid waste at the Dragon Products Co. cement plant in Thomaston, Maine, the tribe's researchers found that the waste dust, mixed with water, could remove sulfur pollutants. The sulfur compounds can be converted to valuable by-products that generate enough revenue to pay for the process.

## Walking Tall

A Kansas City, Mo., firm has announced a portable device that trains people to correct their own curvature of the spine. Developed by Rockefeller University researchers, Micro Straight's artificial-intelligence system repeatedly measures a spine's length and "teaches" people to use their own muscles to stand straight.

Micro Straight's processor—the size of a deck of cards—is worn on the chest. A flexible nylon cord, looped around the torso, measures the spine's curvature 10 times per second. When the wearer slouches for 20 seconds, the device emits a soft tone that gets louder if the posture isn't corrected.

## Scribe's Sign

Besides teaching medieval literature, John Friedman is a detective of sorts. Having stored hundreds of fourteenth- and fifteenth-century English documents on a computer, Friedman is examining the handwriting of the 20 or more obscure scribes from bustling York and Durham workshops of that era.

Friedman has developed a way to computer-digitize Gothic letters taken from slides of original manuscripts. He and his colleagues at the University of Illinois want to determine the precise stroke patterns that went into making letters and groups of letters. Then, using artificial-intelligence programs, the

researchers hope to pinpoint the thousands of individual flourishes that make a pattern—and ultimately identify individual scribes.

## Evaluating Biotech

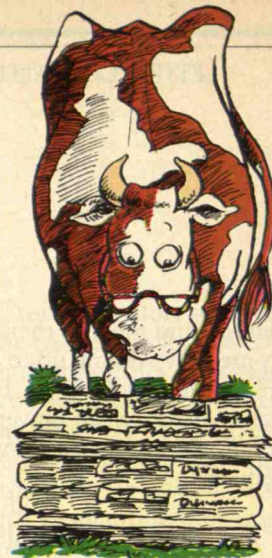
Developing nations need an international advisory panel on biotech, says Stanford University professor of law John Barton, echoing the findings of a Stockholm Environment Institute workshop. Private firms and government agencies from developed countries have begun to test genetically engineered plants, microorganisms, and vaccines in Third World countries that lack the financial and scientific resources to evaluate the experiments.

About 10 experts would review proposals that a company or agency submits. The panel would make informal recommendations about the proposals' safety and feasibility, and a nation's participation would be voluntary.

## R&D Declines

According to the OECD publication *Main Science and Technology Indicators 1990-92*, R&D expenditures are declining widely. In the early 1980s, R&D grew faster than GDP in virtually every nation in the 24-member OECD. But since 1985, only Japan and perhaps Switzerland remain on target.

In the United States, the decline has been steady since 1985, when military R&D peaked. Even industry-financed civilian R&D grew more slowly than GDP in the last half decade. Thus, for the first time, Germany has surpassed the United States in the fraction of its GDP devoted to such investments, and Japan may have done so as well.



## News Bites

Cows might eventually satisfy up to 40 percent of their daily food needs with newsprint, reports *Magazine Week*. Based on early findings from a two-year study, University of Illinois agricultural scientist Larry Berger thinks a large cow might eat 10 pounds of today's news instead of hay.

"Our approach is to increase the digestibility [of newsprint] by treating it with a chemical that is similar to the chemicals found in the animals' stomach," Berger explains.

## Dolphin Sonar

Edward Titlebaum wants to endow communications and sonar systems with some of the abilities that dolphins have. "We should learn from the sonar systems nature has provided," says the University of Rochester electrical engineer. Titlebaum mathematically represents dolphins' sophisticated signals and devises codes that allow scientists to squeeze more signals into a crowded electromagnetic field.

The research could multiply the number of channels available for cellular phones, computer networks, sonar, radar, and satellite communications. But the first customers will probably be Titlebaum's funders, the Navy and SDI. The military is interested because interference from many sources can cause sonar-guided torpedoes to crash into the wrong targets or one another.



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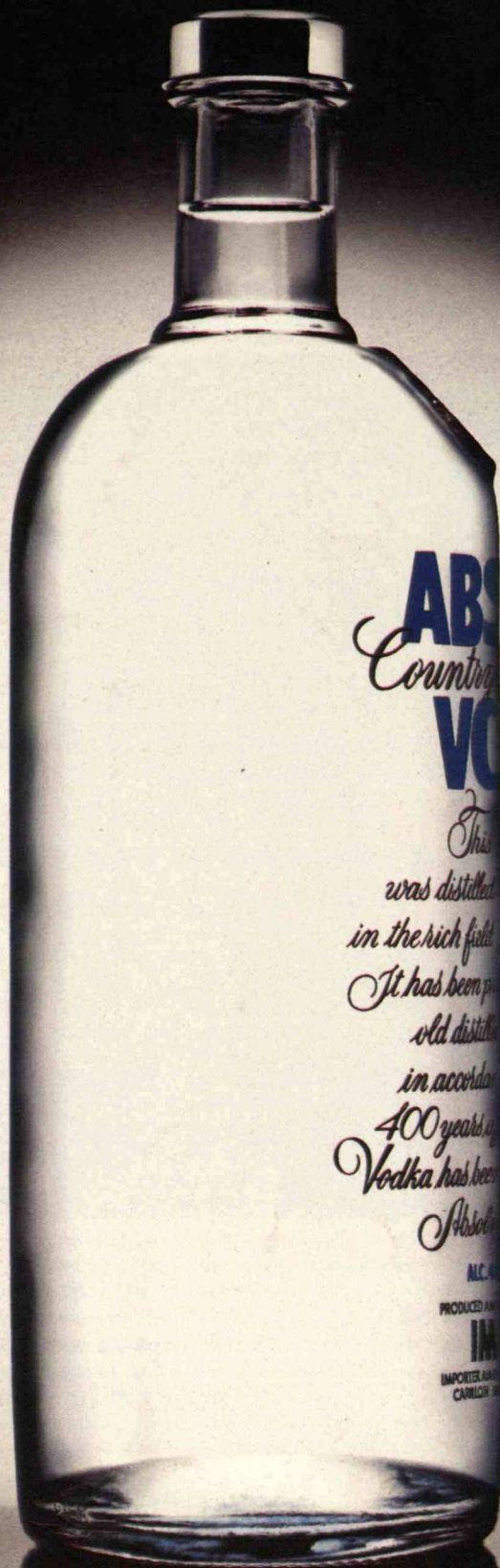
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